

(19) Europäisches Patentamt
European Patent Office
Office européen des brevets



(11) EP 0 946 022 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
29.09.1999 Bulletin 1999/39

(51) Int. Cl.⁶: H04L 12/58, H04L 29/06,
H04L 12/22

(21) Application number: 99105140.0

(22) Date of filing: 26.03.1999

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: 26.03.1998 JP 7983798
18.06.1998 JP 17193098
07.08.1998 JP 22486198
05.11.1998 JP 31517298

(71) Applicant:
Nippon Telegraph and Telephone Corporation
Tokyo (JP)

(72) Inventors:
• Hisada, Yusuke
Nippon Telegraph Telephone Corp
Shinjuku-ku, Tokyo 163-14 (JP)
• Ono, Satoshi
Nippon Telegraph Telephone Corp
Shinjuku-ku, Tokyo 163-14 (JP)
• Ichikawa, Haruhisa
Nippon Telegraph Telephone Corp
Shinjuku-ku, Tokyo 163-14 (JP)

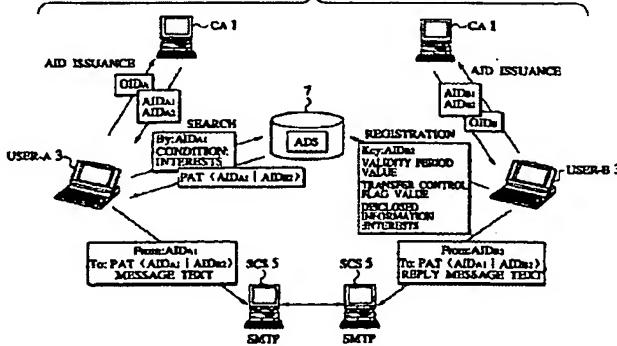
(74) Representative: HOFFMANN - EITLE
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) Email access control scheme for communication network using identification concealment mechanism

(57) An email access control scheme capable of resolving problems of the real email address and enabling a unique identification of the identity of the user while concealing the user identification is disclosed. A personalized access ticket containing a sender's identification and a recipient's identification in correspondence is to be presented by a sender who wishes to send an email to a recipient so as to specify the recipient as an intended destination of the email. Then, accesses between the sender and the recipient by verifying an access right of the sender with respect to the recipient

according to the personalized access ticket at a secure communication service. Also, an official identification of each user by which each user is uniquely identifiable by a certification authority, and an anonymous identification of each user containing at least one fragment of the official identification are defined, and each user is identified by the anonymous identification of each user in communications for emails on a communication network.

FIG.1



Description**BACKGROUND OF THE INVENTION****FIELD OF THE INVENTION**

[0001] The present invention relates to an email access control scheme for controlling transmission and reception of emails by controlling accesses for communications from other users whose identifications on the communication network are concealed while concealing an identification of a recipient on the communication network.

DESCRIPTION OF THE BACKGROUND ART

[0002] In conjunction with the spread of the Internet, the SPAM and the harassment using emails are drastically increasing. The SPAM is a generic name for emails or news that are unilaterally sent without any consideration to the recipient's time consumption, economical and mental burdens. The SPAM using emails are also known as UBE (Unsolicited Bulk Emails) or UCE (Unsolicited Commercial Emails).

[0003] The SPAM is sent indiscriminately regardless of the recipient's age, sex, interests, etc., so that the SPAM often contains an uninteresting or unpleasant content for the recipient. Moreover, the time consumption load and the economical load required for receiving the SPAM is not so small. For the business user, the SPAM can cause the lowering of the working efficiency as it becomes hard to find important mails that are buried among the SPAM. Also, as the SPAM is sent to a huge number of users, the SPAM wastes the network resources and in the worst case the SPAM can cause the overloading. As a result, there are cases where mails that are important for the user may be lost. Also, the SPAM is sent either anonymously or by pretending someone else so that there is a need to provide some human resources to handle complaints.

[0004] On the other hand, the harassment is an act for keeping sending mails with unpleasant contents for the user continually on the purpose of causing mental agony or exerting economical and time consumption burdens to the specific user. Similarly as the SPAM, the harassment mails are sent by pretending an actual or virtual third person, so that the identification of the sender is quite difficult. Also, there are cases where a large capacity mail is sent or a large amount of mails are sent in short period of time so that there is a danger of causing the system breakdown.

[0005] In order to deal with the SPAM and the harassment, the mail system is required to satisfy the following requirements.

* **Security**

It is necessary to detect the pretending by the sender and refuse the delivery from the pretending

sender.

* **Strength**

It is necessary to limit the mail capacity in order to circumvent the system breakdown due to the large capacity mail. It is also necessary to limit the number of transmissions in order to circumvent the system breakdown due to the large amount transmission.

* **Compatibility**

It is necessary not to require a considerable change to the implementation of the existing mail system.

* **Handling**

It is necessary not to require a considerable change to the handling of the existing mail system.

The MTA (message Transfer Agent) such as sendmail and qmail detects the forgery of the envelope information and the header information and refuses the delivery. The MTA also refuses mail receiving from a mail server which is a source of the SPAM by referring to the so called black list such as MAPS RBL. The MTA also detects the transmission using someone else's real email address and refuses the delivery by carrying out the signature verification using PGP, S/MIME, TLS, etc. The MTA also limits the message length by partial deletion of the message text.

One of the causes of the SPAM and the harassment is the real email address, and the real email address is associated with the following problems.

User's identity can be guessed from real email address:

The real email address contains an information useful in guessing the identity so that it can be used in selecting the harassment target. For example, the place of employment can be identified from the real domain. Also, the name and the sex can be guessed from the user name.

Real email address can be guessed from user's identity:

The real email address has a universal format of [user name]@[domain name] so that the real email address can be guessed if the user's identity is known, without an explicit knowledge of the real email address itself. For example, if the user's real name is known, the candidates for the user name can be enumerated. Also, if the user's affiliation is known, the candidates for the domain name can be enumerated. Even in the case where the user name is given by a character string which is totally unrelated to the real name, if the naming rule for the user name is known, the user name can be guessed by trial and error transmissions.

Real email address is transferrable:

The real email address can be transferred from one person to another, so that mails can be transmitted even if the real email address is not taught by the holder himself. The transfer of real email

address through mails includes the following cases. By specifying the other's real email address in the cc: line of the mail, that real email address can be transferred to all the recipients specified in the To: line of the mail. Also, by forwarding the mail that contains the real email address of the recipient specified in the To: line in the message text to a third person, that real email address can be transferred to the third person.

Real email address is hard to cancel:

It is difficult to cancel the real email address because if the real email address is cancelled it becomes impossible to read not only the SPAM and the harassment mails but also the important mails as well.

[0006] Cypherpunk remailers and Mixmaster remailers which are collectively known as Anonymous remailers use a scheme for delivering mails after encrypting the real email address and the real domain of the sender. This scheme is called the reply block. The encryption and decryption of the reply block uses a public key and a secret key of the Anonymous remailer so that it is difficult to identify the real email address and the real domain of the sender for any users other than the sender.

[0007] The Anonymous remailers also make it difficult to transfer the real email address because it is difficult to identify the real email address. However, the reply block is transferrable, so that reply mails can be returned to the sender from users other than the recipient.

[0008] AS-Node and nym.alias.net which are collectively known as Pseudonymous servers use mail transmission and reception using a pseudonym account uniquely corresponding to the real email address of the user. The pseudonym account can be arbitrarily created at the user side so that the user can have a pseudonym account from which the real email address is hard to guess. In addition, by the use of the reply block, it is also possible to conceal the real email address and the real domain of the user to the Pseudonymous server. By combining these means, it can be made difficult to identify the real email address and the real domain of the sender for any users other than the sender. Also, the pseudonym account is cancellable so that there is no need to cancel the real email address.

[0009] The Pseudonymous servers also make it difficult to transfer the real email address because it is difficult to identify the real email address. However, the pseudonym account is transferrable so that reply mails can be returned to the sender from users other than the recipient.

[0010] In addition, in order to protect a recipient from the SPAM and the harassment, it is also necessary to reject a connection request from a sender who are exercising such action. For this reason, it is necessary for the communication system to be capable of uniquely identifying the identity of the sender.

[0011] In view of these factors, the communication system is required to be capable of uniquely identifying the identity of the user while concealing the real email address of the user (that is while guaranteeing the anonymity of the user), but in the conventional communication system, it has been difficult to meet both of these requirements simultaneously.

[0012] In order to identify the identity of the user in the mail system, the real email address of that user is necessary. On the other hand, the Anonymous remailers deliver a mail after either encrypting or deleting the real email address of the sender in order to guarantee the anonymity of the sender. In order to identify the identity of the sender under this condition, it is necessary to trace the delivery route of the mail using the traffic analysis. However, the Anonymous remailers may delay the mail delivery or interchange the delivery orders of mails. Also, The Mixmaster remailers deliver the mail by dividing it into plural blocks. For this reason, it is difficult to trace the delivery route by the traffic analysis, and therefore the identification of the identity of the sender is also difficult.

[0013] The Pseudonymous servers also utilize the Anonymous remailers for the mail delivery, so that it is possible to guarantee the anonymity of the sender but it is also difficult to uniquely identify the identity of the sender.

[0014] On the other hand, the German Digital Signature Law allows entry of a pseudonym instead of a real name into a digital certificate for generating the digital signature to be used in communication services. The digital certificate is uniquely assigned to the user so that the identity of the user can be uniquely identified even if the pseudonym is entered. Also, the right for naming the pseudonym is given to the user side so that it is possible to enter the pseudonym from which it is difficult to guess the real name.

SUMMARY OF THE INVENTION

[0015] It is therefore an object of the present invention to provide an email access control scheme in a communication network which is capable of resolving the above described problems of the real email address which is one of the causes of the SPAM and the harassment.

[0016] It is another object of the present invention to provide an email access control scheme in a communication network which is capable of enabling a unique identification of the identity of the user while concealing the user identification.

[0017] In order to resolve the problems associated with the transfer and the cancellation of the real email address, the present invention employs the email access control scheme using a personalized access ticket (PAT). In order to resolve the problem associated with the transfer of the real email address, the destination is specified by the PAT which contains both the real email address of the sender and a real email address of

the recipient. Also, in order to resolve the problem associated with the cancellation of the real email address, a validity period is set in the PAT by a Trusted Third Party. Then, the mail delivery from the sender who presented the PAT with the expired validity period will be refused. Also, instead of cancelling the real email address, the PAT is registered at a secure storage device managed by a secure communication service.

[0018] In other words, the present invention controls accesses in units in which the real email address of the sender and the real email address of the recipient is paired. For this reason, even when the real email address is transferred, it is possible to avoid receiving mails from users to which the real email address has been transferred as long as the PAT is not acquired by these users.

[0019] Also, in the present invention, it is possible to refuse receiving mails without cancelling the real email address because the mail delivery from the sender who presented the PAT with the expired validity period or the PAT that is registered in a database by the recipient will be refused.

[0020] Also, in the present invention, the mail receiving can be resumed without re-acquiring the real email address because the mail receiving can be resumed by deleting the PAT from the above described storage device.

[0021] Also, in the present invention, the time consumption and economical loads required for the mail receiving or downloading at the user side can be reduced because the transmission of mails are refused at the server side.

[0022] In addition, the present invention employs the email access control scheme using an official identification (OID) and an anonymous identification (AID) in order to make it possible to identify the identity of the user while guaranteeing the anonymity of the user.

[0023] Namely, in the present invention, a certificate in which the personal information is signed by a secret key of the Trusted Third Party is assigned to each user in order to uniquely identify each user. This certificate will be referred to as OID. Also, a certificate which contains fragments of the OID information is assigned to each user as a user identifier on a communication network in order to make it possible to identify the identity while guaranteeing the anonymity of the user. This certificate will be referred to as AID.

[0024] Also, in the present invention, the OID is reconstructed by judging the identity of a plurality of AIDs in order to identify the identity of the user. Also, the AID is contained in the PAT and the PAT is authenticated at a secure communication service (SCS) in order to resolve the problems associated with the transfer and the cancellation of the AID.

[0025] Also, in the present invention, the AID is managed in a directory which is accessible for search by unspecified many and which outputs the PAT containing the AID as a destination, in order to meet the user side

demand for being able to admit accesses from unspecified many without revealing the own identity.

[0026] In this way, in the present invention, the identity of the user can be concealed in the mail transmission and reception because the AID only contains fragments of the OID. Also, the identity of the user can be concealed from unspecified many even when the AID is registered at the directory service which is accessible from unspecified many.

[0027] Also, in the present invention, the identity of the user can be identified probabilistically by reconstructing the OID by judging the identity of a plurality of AIDs. For this reason, it is possible to provide a measure against the SPAM and the harassment without revealing the identity.

[0028] Also, in the present invention, it is possible to admit accesses from unspecified many without revealing the identity, by managing the AID rather than the real email address at the directory and outputting the PAT containing the AID as a destination at the directory.

[0029] More specifically, according to one aspect of the present invention there is provided a method of email access control, comprising the steps of: receiving a personalized access ticket containing a sender's identification and a recipient's identification in correspondence, which is presented by a sender who wishes to send an email to a recipient so as to specify the recipient as an intended destination of the email, at a secure communication service for connecting communications between the sender and the receiver; and controlling accesses between the sender and the recipient by verifying an access right of the sender with respect to the recipient according to the personalized access ticket at the secure communication service.

[0030] Also, in this aspect of the present invention, at the controlling step the secure communication service authenticates the personalized access ticket presented by the sender, and refuses a delivery of the email when the personalized access ticket presented by the sender has been altered.

[0031] Also, in this aspect of the present invention, the personalized access ticket is signed by a secret key of a secure processing device which issued the personalized access ticket, and at the controlling step the secure communication service authenticates the personalized access ticket by verifying a signature of the secure processing device in the personalized access ticket using a public key of the secure processing device.

[0032] Also, in this aspect of the present invention, at the receiving step the secure communication service also receives the sender's identification presented by the sender along with the personalized access ticket, and at the controlling step the secure communication service checks whether the sender's identification presented by the sender is contained in the personalized access ticket presented by the sender, and refuses a delivery of the email when the sender's identification presented by the sender is not contained in the person-

alized access ticket presented by the sender.

[0033] Also, in this aspect of the present invention, the personalized access ticket also contains a validity period indicating a period for which the personalized access ticket is valid, and at the controlling step the secure communication service checks the validity period contained in the personalized access ticket presented by the sender and refuses a delivery of the email when the personalized access ticket presented by the sender contains the validity period that has already been expired.

[0034] Also, in this aspect of the present invention, the validity period of the personalized access ticket is set by a trusted third party.

[0035] Also, in this aspect of the present invention, the method can further comprise the step of: issuing the personalized access ticket to the sender at a directory service for managing an identification of each registrant and a disclosed information of each registrant which has a lower secrecy than a personal information, in a state which is accessible for search by unspecified many, in response to search conditions specified by the sender, by using an identification of a registrant whose disclosed information matches the search conditions as the recipient's identification and the sender's identification specified by the sender along with the search conditions.

[0036] Also, in this aspect of the present invention, the method can further comprise the step of: registering in advance the personalized access ticket containing an identification of a specific user from which a delivery of emails to a specific registrant is to be refused as the sender's identification and an identification of the specific registrant as the recipient's identification, at the secure communication service; wherein the controlling step the secure communication service refuses a delivery of the email from the sender when the personalized access ticket presented by the sender is registered therein in advance at the registering step.

[0037] Also, in this aspect of the present invention, the method can further comprise the step of: deleting the personalized access ticket registered at the secure communication service upon request from the specific registrant who registered the personalized access ticket at the registering step.

[0038] Also, in this aspect of the present invention, the personalized access ticket also contains a transfer control flag indicating whether or not the sender should be authenticated by the secure communication service, and at the controlling step, when the transfer control flag contained in the personalized access ticket indicates that the sender should be authenticated, the secure communication service authenticates the sender's identification presented by the sender and refuses a delivery of the email when an authentication of the sender's identification fails.

[0039] Also, in this aspect of the present invention, the authentication of the sender's identification is realized

by a challenge/response procedure between the sender and the secure communication service.

[0040] Also, in this aspect of the present invention, the transfer control flag of the personalized access ticket is set by a trusted third party.

[0041] Also, in this aspect of the present invention, the sender's identification and the recipient's identification in the personalized access ticket can be given by real email addresses of the sender and the recipient.

[0042] Also, in this aspect of the present invention, the sender's identification and the recipient's identification in the personalized access ticket can be given by anonymous identifications of the sender and the recipient, where an anonymous identification of each user contains at least one fragment of an official identification of each user by which each user is uniquely identifiable by a certification authority.

[0043] Also, in this aspect of the present invention, the anonymous identification of each user is an information containing the at least one fragment of the official identification of each user which is signed by the certification authority using a secret key of the certification authority.

[0044] Also, in this aspect of the present invention, the official identification of each user is a character string uniquely assigned to each user by the certification authority and a public key of each user which are signed by a secret key of the certification authority.

[0045] Also, in this aspect of the present invention, the method can further comprise the step of: probabilistically identifying an identity of the sender by reconstructing the official identification of the sender by judging identity of a plurality of anonymous identifications of the sender contained in a plurality of personalized access tickets used by the sender.

[0046] Also, in this aspect of the present invention, an anonymous identification of each user that contains at least one fragment of an official identification of each user by which each user is uniquely identifiable by a certification authority and a link information of each anonymous identification by which each anonymous identification can be uniquely identified can be defined, and the sender's identification and the recipient's identification in the personalized access ticket can be given by a link information of the anonymous identification of the sender and a link information of the anonymous identification of the recipient.

[0047] Also, in this aspect of the present invention, the link information of each anonymous identification is an identifier uniquely assigned to each anonymous identification by the certification authority.

[0048] Also, in this aspect of the present invention, the method can further comprise the step of: probabilistically identifying an identity of the sender by reconstructing the official identification of the sender by judging identity of a plurality of anonymous identifications of the sender corresponding to the link information contained in a plurality of personalized access tickets used by the sender.

[0049] Also, in this aspect of the present invention, the personalized access ticket can contain a single sender's identification and a single recipient's identification in 1-to-1 correspondence.

[0050] Also, in this aspect of the present invention, the personalized access ticket can contain a single sender's identification and a plurality of recipient's identifications in 1-to-N correspondence, where N is an integer greater than 1.

[0051] Also, in this aspect of the present invention, one identification among the single sender's identification and the plurality of recipient's identifications is a holder identification for identifying a holder of the personalized access ticket while other identifications among the single sender's identification and the plurality of recipient's identifications are member identifications for identifying members of a group to which the holder belongs.

[0052] Also, in this aspect of the present invention, the method can further comprise the step of: issuing an identification of each user and an enabler of the identification of each user indicating a right to change the personalized access ticket containing the identification of each user as the holder identification, to each user at a certification authority, such that prescribed processing on the personalized access ticket can be carried out at a secure processing device only by a user who presented both the holder identification contained in the personalized access ticket and the enabler corresponding to the holder identification to the secure processing device.

[0053] Also, in this aspect of the present invention, the certification authority issues the enabler of the identification of each user as an information indicating that it is the enabler and the identification of each user itself which are signed by a secret key of the certification authority.

[0054] Also, in this aspect of the present invention, the prescribed processing includes a generation of a new personalized access ticket, a merging of a plurality of personalized access tickets, a splitting of one personalized access ticket into a plurality of personalized access tickets, a changing of the holder of the personalized access ticket, changing of a validity period of the personalized access ticket, and a changing of a transfer control flag of the personalized access ticket.

[0055] Also, in this aspect of the present invention, a special identification and a special enabler corresponding to the special identification which are known to all users can be defined such that the generation of a new personalized access ticket and the changing of the holder of the personalized access ticket can be carried out by the holder of the personalized access ticket by using the special identification and the special enabler without using an enabler of a member identification.

[0056] Also, in this aspect of the present invention, the special identification is defined to be capable of being used only as the holder identification of the personal-

ized access ticket.

[0057] Also, in this aspect of the present invention, a special identification which is known to all users can be defined such that a read only attribute can be set to the personalized access ticket by using the special identification.

[0058] Also, in this aspect of the present invention, at the controlling step, when the access right of the sender with respect to the recipient is verified according to the personalized access ticket, the secure communication service takes out the recipient's identification from the personalized access ticket by using the sender's identification presented by the sender, converts the mail by using a taken out recipient's identification into a format that can be interpreted by a mail transfer function for actually carrying out a mail delivery processing, and gives the mail after conversion to the mail transfer function by attaching the personalized access ticket.

[0059] According to another aspect of the present invention there is provided a method of email access control, comprising the steps of: defining an official identification of each user by which each user is uniquely identifiable by a certification authority, and an anonymous identification of each user containing at least one fragment of the official identification; and identifying each user by the anonymous identification of each user in communications for emails on a communication network.

[0060] Also, in this aspect of the present invention, the anonymous identification of each user is an information containing the at least one fragment of the official identification of each user which is signed by the certification authority using a secret key of the certification authority.

[0061] Also, in this aspect of the present invention, the official identification of each user is a character string uniquely assigned to each user by the certification authority and a public key of each user which are signed by a secret key of the certification authority.

[0062] Also, in this aspect of the present invention, the method can further comprise the steps of: receiving a personalized access ticket containing a sender's anonymous identification and a recipient's anonymous identification in correspondence, which is presented by a sender who wishes to send an email to a recipient so as to specify the recipient as an intended destination of the email, at a secure communication service for connecting communications between the sender and the receiver; and controlling accesses between the sender and the recipient by verifying an access right of the sender with respect to the recipient according to the personalized access ticket at the secure communication service.

[0063] Also, in this aspect of the present invention, the method can further comprises the step of: probabilistically identifying an identity of the sender at the secure communication service by reconstructing the official identification of the sender while judging identity of a plurality of anonymous identifications of the sender con-

tained in a plurality of personalized access tickets used by the sender.

[0064] Also, in this aspect of the present invention, the defining step can also define a link information of each anonymous identification by which each anonymous identification can be uniquely identified, and each anonymous identification can also contain the link information of each anonymous identification.

[0065] Also, in this aspect of the present invention, the link information of each anonymous identification is an identifier uniquely assigned to each anonymous identification by the certification authority.

[0066] Also, in this aspect of the present invention, the method can further comprises the steps of: receiving a personalized access ticket containing a link information of a sender's anonymous identification and a link information of a recipient's anonymous identification in correspondence, which is presented by a sender who wishes to send an email to a recipient so as to specify the recipient as an intended destination of the email, at a secure communication service for connecting communications between the sender and the receiver; and controlling accesses between the sender and the recipient by verifying an access right of the sender with respect to the recipient according to the personalized access ticket at the secure communication service.

[0067] Also, in this aspect of the present invention, the method can further comprises the step of: probabilistically identifying an identity of the sender by reconstructing the official identification of the sender while judging identity of a plurality of anonymous identifications of the sender corresponding to the link information contained in a plurality of personalized access tickets used by the sender.

[0068] According to another aspect of the present invention there is provided a communication system realizing email access control, comprising: a communication network to which a plurality of user terminals are connected; and a secure communication service device for connecting communications between the sender and the receiver on the communication network, by receiving a personalized access ticket containing a sender's identification and a recipient's identification in correspondence, which is presented by a sender who wishes to send an email to a recipient so as to specify the recipient as an intended destination of the email, and controlling accesses between the sender and the recipient by verifying an access right of the sender with respect to the recipient according to the personalized access ticket.

[0069] Also, in this aspect of the present invention, the secure communication service device authenticates the personalized access ticket presented by the sender, and refuses a delivery of the email when the personalized access ticket presented by the sender has been altered.

[0070] Also, in this aspect of the present invention, the system further comprises: a secure processing device

for issuing the personalized access ticket which is signed by a secret key of the secure processing device; wherein the secure communication service device authenticates the personalized access ticket by verifying a signature of the secure processing device in the personalized access ticket using a public key of the secure processing device.

[0071] Also, in this aspect of the present invention, the secure communication service device also receives the sender's identification presented by the sender along with the personalized access ticket, checks whether the sender's identification presented by the sender is contained in the personalized access ticket presented by the sender, and refuses a delivery of the email when the sender's identification presented by the sender is not contained in the personalized access ticket presented by the sender.

[0072] Also, in this aspect of the present invention, the personalized access ticket also contains a validity period indicating a period for which the personalized access ticket is valid, and the secure communication service device checks the validity period contained in the personalized access ticket presented by the sender and refuses a delivery of the email when the personalized access ticket presented by the sender contains the validity period that has already been expired.

[0073] Also, in this aspect of the present invention, the system further comprises: a trusted third party for setting the validity period of the personalized access ticket.

[0074] Also, in this aspect of the present invention, the system can further comprise: a directory service device for managing an identification of each registrant and a disclosed information of each registrant which has a lower secrecy than a personal information, in a state which is accessible for search by unspecified many, and issuing the personalized access ticket to the sender in response to search conditions specified by the sender, by using an identification of a registrant whose disclosed information matches the search conditions as the recipient's identification and the sender's identification specified by the sender along with the search conditions.

[0075] Also, in this aspect of the present invention, the secure communication service device can register in advance the personalized access ticket containing an identification of a specific user from which a delivery of emails to a specific registrant is to be refused as the sender's identification and an identification of the specific registrant as the recipient's identification, and refuse a delivery of the email from the sender when the personalized access ticket presented by the sender is registered therein in advance.

[0076] Also, in this aspect of the present invention, the secure communication service device can delete the personalized access ticket registered therein upon request from the specific registrant who registered the personalized access ticket.

[0077] Also, in this aspect of the present invention, the

personalized access ticket also contains a transfer control flag indicating whether or not the sender should be authenticated by the secure communication service, and when the transfer control flag contained in the personalized access ticket indicates that the sender should be authenticated, the secure communication service device authenticates the sender's identification presented by the sender and refuses a delivery of the email when an authentication of the sender's identification fails.

[0078] Also, in this aspect of the present invention, the authentication of the sender's identification is realized by a challenge/response procedure between the sender and the secure communication service device.

[0079] Also, in this aspect of the present invention, the system further comprises a trusted third party for setting the transfer control flag of the personalized access ticket.

[0080] Also, in this aspect of the present invention, the sender's identification and the recipient's identification in the personalized access ticket can be given by real email addresses of the sender and the recipient.

[0081] Also, in this aspect of the present invention, the system can further comprise: a certification authority device for issuing an anonymous identification of each user which contains at least one fragment of an official identification of each user by which each user is uniquely identifiable by the certification authority device; wherein the sender's identification and the recipient's identification in the personalized access ticket can be given by anonymous identifications of the sender and the recipient.

[0082] Also, in this aspect of the present invention, the anonymous identification of each user is an information containing the at least one fragment of the official identification of each user which is signed by the certification authority device using a secret key of the certification authority device.

[0083] Also, in this aspect of the present invention, the official identification of each user is a character string uniquely assigned to each user by the certification authority device and a public key of each user which are signed by a secret key of the certification authority device.

[0084] Also, in this aspect of the present invention, the secure communication service device can probabilistically identify an identity of the sender by reconstructing the official identification of the sender while judging identity of a plurality of anonymous identifications of the sender contained in a plurality of personalized access tickets used by the sender.

[0085] Also, in this aspect of the present invention, the system can further comprise: a certification authority device for issuing an anonymous identification of each user which contains at least one fragment of an official identification of each user by which each user is uniquely identifiable by the certification authority device and a link information of each anonymous identification

by which each anonymous identification can be uniquely identified; wherein the sender's identification and the recipient's identification in the personalized access ticket can be given by a link information of the anonymous identification of the sender and a link information of the anonymous identification of the recipient.

5 [0086] Also, in this aspect of the present invention, the link information of each anonymous identification is an identifier uniquely assigned to each anonymous identification by the certification authority device.

[0087] Also, in this aspect of the present invention, the secure communication service device can probabilistically identify an identity of the sender by reconstructing the official identification of the sender while judging

10 15 identity of a plurality of anonymous identifications of the sender corresponding to the link information contained in a plurality of personalized access tickets used by the sender.

[0088] Also, in this aspect of the present invention, the personalized access ticket can contain a single sender's identification and a single recipient's identification in 1-to-1 correspondence.

[0089] Also, in this aspect of the present invention, the personalized access ticket can contain a single sender's 20 25 identification and a plurality of recipient's identifications in 1-to-N correspondence, where N is an integer greater than 1.

[0090] Also, in this aspect of the present invention, one identification among the single sender's identification and the plurality of recipient's identifications is a holder identification for identifying a holder of the personalized access ticket while other identifications among the single sender's identification and the plurality of recipient's identifications are member identifications for identifying members of a group to which the holder belongs.

[0091] Also, in this aspect of the present invention, the system can further comprise: a certification authority device for issuing to each user an identification of each user and an enabler of the identification of each user indicating a right to change the personalized access ticket containing the identification of each user as the holder identification; and a secure processing device at which prescribed processing on the personalized access ticket can be carried out only by a user who presented both the holder identification contained in the personalized access ticket and the enabler corresponding to the holder identification to the secure processing device.

40 45 50 [0092] Also, in this aspect of the present invention, the certification authority device issues the enabler of the identification of each user as an information indicating that it is the enabler and the identification of each user itself which are signed by a secret key of the certification authority device.

[0093] Also, in this aspect of the present invention, the prescribed processing includes a generation of a new personalized access ticket, a merging of a plurality of

personalized access tickets, a splitting of one personalized access ticket into a plurality of personalized access tickets, a changing of the holder of the personalized access ticket, changing of a validity period of the personalized access ticket, and a changing of a transfer control flag of the personalized access ticket.

[0094] Also, in this aspect of the present invention, a special identification and a special enabler corresponding to the special identification which are known to all users can be defined such that the generation of a new personalized access ticket and the changing of the holder of the personalized access ticket can be carried out by the holder of the personalized access ticket by using the special identification and the special enabler without using an enabler of a member identification.

[0095] Also, in this aspect of the present invention, the special identification is defined to be capable of being used only as the holder identification of the personalized access ticket.

[0096] Also, in this aspect of the present invention, a special identification which is known to all users can be defined such that a read only attribute can be set to the personalized access ticket by using the special identification.

[0097] Also, in this aspect of the present invention, when the access right of the sender with respect to the recipient is verified according to the personalized access ticket, the secure communication service device takes out the recipient's identification from the personalized access ticket by using the sender's identification presented by the sender, converts the mail by using a taken out recipient's identification into a format that can be interpreted by a mail transfer function for actually carrying out a mail delivery processing, and gives the mail after conversion to the mail transfer function by attaching the personalized access ticket.

[0098] According to another aspect of the present invention there is provided a communication system realizing email access control, comprising: a certification authority device for defining an official identification of each user by which each user is uniquely identifiable by the certification authority device, and an anonymous identification of each user which contains at least one fragment of the official identification; and a communication network on which each user is identified by the anonymous identification of each user in communications for emails on the communication network.

[0099] Also, in this aspect of the present invention, the anonymous identification of each user is an information containing the at least one fragment of the official identification of each user which is signed by the certification authority device using a secret key of the certification authority device.

[0100] Also, in this aspect of the present invention, the official identification of each user is a character string uniquely assigned to each user by the certification authority device and a public key of each user which are signed by a secret key of the certification authority

device.

[0101] Also, in this aspect of the present invention, the system can further comprises: a secure communication service device for connecting communications between the sender and the receiver on the communication network, by receiving a personalized access ticket containing a sender's anonymous identification and a recipient's anonymous identification in correspondence, which is presented by a sender who wishes to send an email to a recipient so as to specify the recipient as an intended destination of the email, and controlling accesses between the sender and the recipient by verifying an access right of the sender with respect to the recipient according to the personalized access ticket.

[0102] Also, in this aspect of the present invention, the secure communication service device can probabilistically identify an identity of the sender by reconstructing the official identification of the sender while judging identity of a plurality of anonymous identifications of the sender contained in a plurality of personalized access tickets used by the sender.

[0103] Also, in this aspect of the present invention, the certification authority device can also define a link information of each anonymous identification by which each anonymous identification can be uniquely identified, and each anonymous identification can also contain the link information of each anonymous identification.

[0104] Also, in this aspect of the present invention, the link information of each anonymous identification is an identifier uniquely assigned to each anonymous identification by the certification authority device.

[0105] Also, in this aspect of the present invention, the system can further comprise: a secure communication service device for connecting communications between the sender and the receiver on the communication network, by receiving a personalized access ticket containing a link information of a sender's anonymous identification and a link information of a recipient's anonymous identification in correspondence, which is presented by a sender who wishes to send an email to a recipient so as to specify the recipient as an intended destination of the email, and controlling accesses between the sender and the recipient by verifying an access right of the sender with respect to the recipient according to the personalized access ticket.

[0106] Also, in this aspect of the present invention, the secure communication service device can probabilistically identify an identity of the sender by reconstructing the official identification of the sender while judging identity of a plurality of link informations of anonymous identifications of the sender contained in a plurality of personalized access tickets used by the sender.

[0107] According to another aspect of the present invention there is provided a secure communication service device for use in a communication system realizing email access control, comprising: a computer hardware; and a computer software for causing the computer hardware to connect communications

between the sender and the receiver, by receiving a personalized access ticket containing a sender's identification and a recipient's identification in correspondence, which is presented by a sender who wishes to send an email to a recipient so as to specify the recipient as an intended destination of the email, and controlling accesses between the sender and the recipient by verifying an access right of the sender with respect to the recipient according to the personalized access ticket.

[0108] Also, in this aspect of the present invention, the computer software causes the computer hardware to authenticate the personalized access ticket presented by the sender, and refuse a delivery of the email when the personalized access ticket presented by the sender has been altered.

[0109] Also, in this aspect of the present invention, the personalized access ticket is signed by a secret key of a secure processing device which issued the personalized access ticket, and the computer software causes the computer hardware to authenticate the personalized access ticket by verifying a signature of the secure processing device in the personalized access ticket using a public key of the secure processing device.

[0110] Also, in this aspect of the present invention, the computer software causes the computer hardware to also receive the sender's identification presented by the sender along with the personalized access ticket, check whether the sender's identification presented by the sender is contained in the personalized access ticket presented by the sender, and refuse a delivery of the email when the sender's identification presented by the sender is not contained in the personalized access ticket presented by the sender.

[0111] Also, in this aspect of the present invention, the personalized access ticket also contains a validity period indicating a period for which the personalized access ticket is valid, and the computer software causes the computer hardware to check the validity period contained in the personalized access ticket presented by the sender and refuse a delivery of the email when the personalized access ticket presented by the sender contains the validity period that has already been expired.

[0112] Also, in this aspect of the present invention, the computer software can cause the computer hardware to register in advance the personalized access ticket containing an identification of a specific user from which a delivery of emails to a specific registrant is to be refused as the sender's identification and an identification of the specific registrant as the recipient's identification, at the secure communication service device, and refuse a delivery of the email from the sender when the personalized access ticket presented by the sender is registered at the secure communication service device in advance.

[0113] Also, in this aspect of the present invention, the computer software can cause the computer hardware to delete the personalized access ticket registered at the

secure communication service device upon request from the specific registrant who registered the personalized access ticket.

[0114] Also, in this aspect of the present invention, the personalized access ticket also contains a transfer control flag indicating whether or not the sender should be authenticated by the secure communication service device, and when the transfer control flag contained in the personalized access ticket indicates that the sender should be authenticated, the computer software causes the computer hardware to authenticate the sender's identification presented by the sender and refuse a delivery of the email when an authentication of the sender's identification fails.

[0115] Also, in this aspect of the present invention, the computer software causes the computer hardware to realize the authentication of the sender's identification by a challenge/response procedure between the sender and the secure communication service device.

[0116] Also, in this aspect of the present invention, the sender's identification and the recipient's identification in the personalized access ticket can be given by anonymous identifications of the sender and the recipient, where an anonymous identification of each user contains at least one fragment of an official identification of each user by which each user is uniquely identifiable by a certification authority, and the computer software can also cause the computer hardware to probabilistically identify an identity of the sender by reconstructing the official identification of the sender by judging identity of a plurality of anonymous identifications of the sender contained in a plurality of personalized access tickets used by the sender.

[0117] Also, in this aspect of the present invention, an anonymous identification of each user that contains at least one fragment of an official identification of each user by which each user is uniquely identifiable by a certification authority and a link information of each anonymous identification by which each anonymous identification can be uniquely identified can be defined, the sender's identification and the recipient's identification in the personalized access ticket can be given by a link information of the anonymous identification of the sender and a link information of the anonymous identification of the recipient, and the computer software can also cause the computer hardware to probabilistically identify an identity of the sender by reconstructing the official identification of the sender by judging identity of a plurality of anonymous identifications of the sender corresponding to the link information contained in a plurality of personalized access tickets used by the sender.

[0118] Also, in this aspect of the present invention, when the access right of the sender with respect to the recipient is verified according to the personalized access ticket, the computer software causes the computer hardware to take out the recipient's identification from the personalized access ticket by using the sender's identification presented by the sender, convert

the mail by using a taken out recipient's identification into a format that can be interpreted by a mail transfer function for actually carrying out a mail delivery processing, and give the mail after conversion to the mail transfer function by attaching the personalized access ticket.

[0119] According to another aspect of the present invention there is provided a secure processing device for use in a communication system realizing email access control, comprising: a computer hardware; and a computer software for causing the computer hardware to receive a request for a personalized access ticket from a user, and issue a personalized access ticket containing a sender's identification and a recipient's identification in correspondence, which is signed by a secret key of the secure processing device.

[0120] According to another aspect of the present invention there is provided a directory service device for use in a communication system realizing email access control, comprising: a computer hardware; and a computer software for causing the computer hardware to manage an identification of each registrant and a disclosed information of each registrant which has a lower secrecy than a personal information, in a state which is accessible for search by unspecified many, and issue a personalized access ticket containing a sender's identification and a recipient's identification in correspondence, to the sender in response to search conditions specified by the sender, by using an identification of a registrant whose disclosed information matches the search conditions as the recipient's identification and the sender's identification specified by the sender along with the search conditions.

[0121] According to another aspect of the present invention there is provided a certification authority device for use in a communication system realizing email access control, comprising: a computer hardware; and a computer software for causing the computer hardware to issue to each user an official identification of each user by which each user is uniquely identifiable by the certification authority device, and an anonymous identification of each user which contains at least one fragment of the official identification.

[0122] According to another aspect of the present invention there is provided a certification authority device for use in a communication system realizing email access control, comprising: a computer hardware; and a computer software for causing the computer hardware to issue to each user an identification of each user and an enabler of the identification of each user indicating a right to change any personalized access ticket that contains the identification of each user as a holder identification, where the personalized access ticket generally contains a sender's identification and a plurality of recipient's identifications in correspondence, and one of the sender's identification and the recipient's identifications is a holder identification.

[0123] According to another aspect of the present

invention there is provided a secure processing device for use in a communication system realizing email access control, comprising: a computer hardware; and a computer software for causing the computer hardware to receive from a user a request for prescribed processing on a personalized access ticket containing a sender's identification and a plurality of recipient's identifications in correspondence, where one of the sender's identification and the recipient's identifications is a holder identification, and execute the prescribed processing on the personalized access ticket when the user presented both the holder identification contained in the personalized access ticket and an enabler corresponding to the holder identification which indicates a right to change the personalized access ticket containing the identification of the user as the holder identification.

[0124] According to another aspect of the present invention there is provided a computer usable medium having computer readable program code means embodied therein for causing a computer to function as a secure communication service device for use in a communication system realizing email access control, the computer readable program code means includes: first computer readable program code means for causing said computer to receive a personalized access ticket containing a sender's identification and a recipient's identification in correspondence, which is presented by a sender who wishes to send an email to a recipient so as to specify the recipient as an intended destination of the email; and second computer readable program code means for causing said computer to control accesses between the sender and the recipient by verifying an access right of the sender with respect to the recipient according to the personalized access ticket, so as to connect communications between the sender and the receiver on the communication network.

[0125] Also, in this aspect of the present invention, the second computer readable program code means causes said computer to authenticate the personalized access ticket presented by the sender, and refuse a delivery of the email when the personalized access ticket presented by the sender has been altered.

[0126] Also, in this aspect of the present invention, the personalized access ticket is signed by a secret key of a secure processing device which issued the personalized access ticket, and the second computer readable program code means causes said computer to authenticate the personalized access ticket by verifying a signature of the secure processing device in the personalized access ticket using a public key of the secure processing device.

[0127] Also, in this aspect of the present invention, the first computer readable program code means causes said computer to also receive the sender's identification presented by the sender along with the personalized access ticket, and the second computer readable program code means causes said computer to check

whether the sender's identification presented by the sender is contained in the personalized access ticket presented by the sender and refuse a delivery of the email when the sender's identification presented by the sender is not contained in the personalized access ticket presented by the sender.

[0128] Also, in this aspect of the present invention, the personalized access ticket also contains a validity period indicating a period for which the personalized access ticket is valid, and the second computer readable program code means causes said computer to check the validity period contained in the personalized access ticket presented by the sender and refuse a delivery of the email when the personalized access ticket presented by the sender contains the validity period that has already been expired.

[0129] Also, in this aspect of the present invention, the second computer readable program code means can cause said computer to register in advance the personalized access ticket containing an identification of a specific user from which a delivery of emails to a specific registrant is to be refused as the sender's identification and an identification of the specific registrant as the recipient's identification, at the secure communication service device, and refuse a delivery of the email from the sender when the personalized access ticket presented by the sender is registered at the secure communication service device in advance.

[0130] Also, in this aspect of the present invention, the second computer readable program code means can cause said computer to delete the personalized access ticket registered at the secure communication service device upon request from the specific registrant who registered the personalized access ticket.

[0131] Also, in this aspect of the present invention, the personalized access ticket also contains a transfer control flag indicating whether or not the sender should be authenticated by the secure communication service device, and when the transfer control flag contained in the personalized access ticket indicates that the sender should be authenticated, the second computer readable program code means causes said computer to authenticate the sender's identification presented by the sender and refuse a delivery of the email when an authentication of the sender's identification fails.

[0132] Also, in this aspect of the present invention, the second computer readable program code means causes said computer to realize the authentication of the sender's identification by a challenge/response procedure between the sender and the secure communication service device.

[0133] Also, in this aspect of the present invention, the sender's identification and the recipient's identification in the personalized access ticket can be given by anonymous identifications of the sender and the recipient, where an anonymous identification of each user contains at least one fragment of an official identification of each user by which each user is uniquely identifiable by

a certification authority, and the second computer readable program code means can also cause said computer to probabilistically identify an identity of the sender by reconstructing the official identification of the sender by judging identity of a plurality of anonymous identifications of the sender contained in a plurality of personalized access tickets used by the sender.

[0134] Also, in this aspect of the present invention, an anonymous identification of each user that contains at least one fragment of an official identification of each user by which each user is uniquely identifiable by a certification authority and a link information of each anonymous identification by which each anonymous identification can be uniquely identified can be defined, the sender's identification and the recipient's identification in the personalized access ticket can be given by a link information of the anonymous identification of the sender and a link information of the anonymous identification of the recipient, and the second computer readable program code means can also cause said computer to probabilistically identify an identity of the sender by reconstructing the official identification of the sender by judging identity of a plurality of anonymous identifications of the sender corresponding to the link information contained in a plurality of personalized access tickets used by the sender.

[0135] Also, in this aspect of the present invention, when the access right of the sender with respect to the recipient is verified according to the personalized access ticket, the second computer readable program code means causes said computer to take out the recipient's identification from the personalized access ticket by using the sender's identification presented by the sender, convert the mail by using a taken out recipient's identification into a format that can be interpreted by a mail transfer function for actually carrying out a mail delivery processing, and give the mail after conversion to the mail transfer function by attaching the personalized access ticket.

[0136] According to another aspect of the present invention there is provided a computer usable medium having computer readable program code means embodied therein for causing a computer to function as a secure processing device for use in a communication system realizing email access control, the computer readable program code means includes: first computer readable program code means for causing said computer to receive a request for a personalized access ticket from a user; and second computer readable program code means for causing said computer to issue the personalized access ticket containing a sender's identification and a recipient's identification in correspondence, which is signed by a secret key of the secure processing device.

[0137] According to another aspect of the present invention there is provided a computer usable medium having computer readable program code means embodied therein for causing a computer to function as

a directory service device for use in a communication system realizing email access control, the computer readable program code means includes: first computer readable program code means for causing said computer to manage an identification of each registrant and a disclosed information of each registrant which has a lower secrecy than a personal information, in a state which is accessible for search by unspecified many, and second computer readable program code means for causing said computer to issue a personalized access ticket containing a sender's identification and a recipient's identification in correspondence, to the sender in response to search conditions specified by the sender, by using an identification of a registrant whose disclosed information matches the search conditions as the recipient's identification and the sender's identification specified by the sender along with the search conditions.

[0138] According to another aspect of the present invention there is provided a computer usable medium having computer readable program code means embodied therein for causing a computer to function as a certification authority device for use in a communication system realizing email access control, the computer readable program code means includes: first computer readable program code means for causing said computer to issue to each user an official identification of each user by which each user is uniquely identifiable by the certification authority device; and second computer readable program code means for causing said computer to issue to each user an anonymous identification of each user which contains at least one fragment of the official identification.

[0139] According to another aspect of the present invention there is provided a computer usable medium having computer readable program code means embodied therein for causing a computer to function as a certification authority device for use in a communication system realizing email access control, the computer readable program code means includes: first computer readable program code means for causing said computer to issue to each user an identification of each user; and second computer readable program code means for causing said computer to issue to each user an enabler of the identification of each user indicating a right to change any personalized access ticket that contains the identification of each user as a holder identification, where the personalized access ticket generally contains a sender's identification and a plurality of recipient's identifications in correspondence, and one of the sender's identification and the recipient's identifications is a holder identification.

[0140] According to another aspect of the present invention there is provided a computer usable medium having computer readable program code means embodied therein for causing a computer to function as a secure processing device for use in a communication system realizing email access control, the computer

readable program code means includes: first computer readable program code means for causing said computer to receive from a user a request for prescribed processing on a personalized access ticket containing a sender's identification and a plurality of recipient's identifications in correspondence, where one of the sender's identification and the recipient's identifications is a holder identification; and second computer readable program code means for causing said computer to execute the prescribed processing on the personalized access ticket when the user presented both the holder identification contained in the personalized access ticket and an enabler corresponding to the holder identification which indicates a right to change the personalized access ticket containing the identification of the user as the holder identification.

[0141] Other features and advantages of the present invention will become apparent from the following description taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0142]

- 25 Fig. 1 is a diagram showing an overall configuration of a communication system according to the first embodiment of the present invention.
- 30 Fig. 2 is a diagram showing exemplary data structures of an official identification, an anonymous identification, and a 1-to-1 personalized access ticket according to the first embodiment of the present invention.
- 35 Fig. 3 is a flow chart for an anonymous identification generation processing at a certification authority according to the first embodiment of the present invention.
- 40 Fig. 4 is a flow chart for a personalized access ticket generation processing at an anonymous directory service according to the first embodiment of the present invention.
- 45 Fig. 5 is a flow chart for a mail access control processing at a secure communication service according to the first embodiment of the present invention.
- 50 Fig. 6 is a flow chart for an anonymous identification identity judgement processing at a secure communication service according to the first embodiment of the present invention.
- 55 Fig. 7 is a diagram showing exemplary data structures of data used in the anonymous identification identity judgement processing of Fig. 6.
- Fig. 8 is a diagram showing exemplary data structures of an official identification, an anonymous identification, and a 1-to-N personalized access ticket according to the second embodiment of the present invention.
- Fig. 9 is a diagram showing exemplary data struc-

tures of an anonymous identification and an enabler according to the second embodiment of the present invention.

Fig. 10 is a diagram showing a definition of a processing rule (MakePAT) used in the second embodiment of the present invention. 5

Fig. 11 is a diagram showing a definition of a processing rule (MergePAT) used in the second embodiment of the present invention.

Fig. 12 is a diagram showing a definition of a processing rule (SplitPAT) used in the second embodiment of the present invention. 10

Fig. 13 is a diagram showing a definition of a processing rule (TransPAT) used in the second embodiment of the present invention. 15

Fig. 14 is a first exemplary system configuration that can be used in the second embodiment of the present invention.

Fig. 15 is a second exemplary system configuration that can be used in the second embodiment of the present invention. 20

Fig. 16 is a third exemplary system configuration that can be used in the second embodiment of the present invention.

Fig. 17 is a fourth exemplary system configuration that can be used in the second embodiment of the present invention. 25

Fig. 18 is a fifth exemplary system configuration that can be used in the second embodiment of the present invention.

Fig. 19 is a sixth exemplary system configuration that can be used in the second embodiment of the present invention.

Fig. 20 is a seventh exemplary system configuration that can be used in the second embodiment of the present invention. 30

Fig. 21 is a flow chart showing an overall processing flow of MakePAT, MergePAT or TransPAT processing according to the second embodiment of the present invention. 35

Fig. 22 is a flow chart showing an overall processing flow of SplitPAT processing according to the second embodiment of the present invention.

Fig. 23 is a flow chart for an anonymous identification list generation processing (for MakePAT, MergePAT, SplitPAT and TransPAT) according to the second embodiment of the present invention. 40

Fig. 24 is an enabler authenticity verification processing (for MakePAT, MergePAT, SplitPAT and TransPAT) according to the second embodiment of the present invention. 45

Fig. 25 is a diagram showing an exemplary data structure of Null-AID used in the third embodiment of the present invention.

Fig. 26 is a diagram showing an exemplary data structure of Enabler of Null-AID used in the third embodiment of the present invention. 50

Fig. 27 is a diagram showing a first exemplary appli-

cation of the third embodiment of the present invention.

Fig. 28 is a diagram showing a second exemplary application of the third embodiment of the present invention.

Fig. 29 is a diagram showing an exemplary data structure of God-AID used in the fourth embodiment of the present invention.

Fig. 30 is a diagram showing a first exemplary application of the fourth embodiment of the present invention.

Fig. 31 is a diagram showing a second exemplary application of the fourth embodiment of the present invention.

Fig. 32 is a flow chart for a member anonymous identification checking processing according to the fifth embodiment of the present invention.

Fig. 33 is a diagram showing an overall configuration of a communication system according to the sixth embodiment of the present invention.

Fig. 34 is a diagram showing exemplary data structures of an official identification, a link information attached anonymous identification, and a link specifying 1-to-1 personalized access ticket according to the sixth embodiment of the present invention.

Fig. 35 is a flow chart for a link information attached anonymous identification generation processing at a certification authority according to the sixth embodiment of the present invention.

Fig. 36 is a flow chart for a link specifying 1-to-1 personalized access ticket generation processing at an anonymous directory service according to the sixth embodiment of the present invention.

Fig. 37 is a flow chart for a mail access control processing at a secure communication service according to the sixth embodiment of the present invention.

Fig. 38 is a flow chart for an anonymous identification identity judgement processing at a secure communication service according to the sixth embodiment of the present invention.

Fig. 39 is a diagram showing exemplary data structures of data used in the anonymous identification identity judgement processing of Fig. 38.

Fig. 40 is a diagram showing exemplary data structures of an official identification, a link information attached anonymous identification, and a link specifying 1-to-N personalized access ticket according to the seventh embodiment of the present invention.

Fig. 41 is a diagram showing exemplary data structures of a link information attached anonymous identification and an enabler according to the seventh embodiment of the present invention.

Fig. 42 is a first exemplary system configuration that can be used in the seventh embodiment of the present invention.

Fig. 43 is a second exemplary system configuration

that can be used in the seventh embodiment of the present invention.

Fig. 44 is a third exemplary system configuration that can be used in the seventh embodiment of the present invention.

Fig. 45 is a fourth exemplary system configuration that can be used in the seventh embodiment of the present invention.

Fig. 46 is a fifth exemplary system configuration that can be used in the seventh embodiment of the present invention.

Fig. 47 is a sixth exemplary system configuration that can be used in the seventh embodiment of the present invention.

Fig. 48 is a seventh exemplary system configuration that can be used in the seventh embodiment of the present invention.

Fig. 49 is a flow chart for a link specifying anonymous identification list generation processing (for MakePAT, MergePAT, SplitPAT and TransPAT) according to the seventh embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0143] Referring now to Fig. 1 to Fig. 7, the first embodiment of the email access control scheme according to the present invention will be described in detail.

[0144] The email access control scheme of the present invention enables bidirectional communications between a sender and a recipient appropriately while maintaining anonymity of a sender and a recipient on a communication network. Basically, this is realized by disclosing only information indicative of characteristics of recipients in a state of concealing true identifiers of the recipients, and assigning limited access rights with respect to those who wish to carry out communications while maintaining the anonymity according to the disclosed information.

[0145] More specifically, an Anonymous Identification (abbreviated hereafter as AID) that functions as a role identifier in which a personal information is concealed is assigned to a user, and this AID is disclosed on the network in combination with an information indicative of characteristics of the user such as his/her interests, age, job, etc., which cannot be used in identifying the user on the network but which can be useful for a sender in judging whether or not it is worth communicating with that user.

[0146] Also, the sender can search out a recipient with whom he/she wishes to communicate by reading or searching through the disclosed information. Namely, in the case where the sender wishes to communicate with a recipient while maintaining his/her own anonymity, the sender specifies the AID of that recipient and acquires a Personalized Access Ticket (abbreviated hereafter as

PAT). The PAT contains the AIDs of the sender and the recipient as well as information regarding a transfer control flag and a validity period. The transfer control flag is used in order to determine whether a Secure Communication Service (abbreviated hereafter as SCS) to be described below carries out the authentication with respect to the sender. Namely, when the transfer control flag is set ON, the SCS will carry out the authentication such as signature verification for example, with respect to the sender at a time of the connection request. On the other hand, when the transfer control flag is set OFF, the SCS will give the connection request to a physical communication network to which the SCS is connected, without carrying out the authentication. In other words, the transfer control is used in order to verify whether or not the AID is properly utilized by the user to whom it is allocated by a Certification Authority (abbreviated hereafter as CA).

[0147] In the communication network realizing the email access control scheme of the present invention, the assignment of AIDs with respect to users, the maintenance of information disclosed in combination with AIDs, the issuance of PATs, and the email access control based on PATs are realized by separate organizations. This is because it is more convenient to realize them by separate organizations from a perspective of maintaining the security of the entire network, since security levels to be maintained in relation to respective actions are different. Note however that the maintenance of the disclosed information and the issuance of PATs may be realized by the same organization.

[0148] Fig. 1 shows an overall configuration of a communication system in this first embodiment, which is directed to the email service on Internet or Intranet.

[0149] In Fig. 1, the CA (Certification Authority) 1 has a right to authenticate an Official Identification (abbreviated hereafter as OID) that identifies each individual and a right to issue AIDs, and functions to generate AIDs from OIDs and allocate AIDs to users 3.

[0150] The SCS (Secure Communication Service) 5 judges whether or not to admit a connection in response to a connection request by an email from a user 3, according to the PAT (Personalized Access Ticket) presented from a user 3. The SCS 5 also rejects a connection request by an email according to a request from a user 3. The SCS 5 also judges the identity of OIDs according to a request from a user 3.

[0151] An Anonymous Directory Service (abbreviated hereafter as ADS) 7 is a database for managing the AID, the transfer control flag value, the validity period value, and the disclosed information (such as interests, which can be regarded as requiring a lower secrecy compared with a personal information such as name, telephone number, and real email address) of each user 3. The ADS 7 has a function to generate the PAT from the AID of a user 3 who presented search conditions, the AID of a user 3 who has been registering the disclosed information that matches the search conditions

in the ADS 7, the transfer control flag value given from a user 3 or administrators of the ADS, and the validity period value given from a user 3 or administrators of the ADS, and then allocate the PAT to a user 3 who presented the search conditions.

[0152] First, a series of processing from generating the AID from the OID according to a request from a user until allocating the AID to that user will be described.

[0153] Fig. 2 shows exemplary formats of the OID, the AID, and the PAT. As shown in a part (a) of Fig. 2, the OID is an information comprising an arbitrary character string according to a rule by which the CA 1 can uniquely identify the user and a public key, which is signed by the CA 1 using a secret key of the CA 1.

[0154] Also, as shown in a part (b) of Fig. 2, the AID is an information comprising fragments of the OID and their position information, redundant character strings, and an SCS information given by an arbitrary character string (host name, real domain name, etc.) by which a host or a domain that is operating the SCS 5 can be uniquely identified on the network, which is signed by the CA 1 using the secret key of the CA 1.

[0155] Also, as shown in a part (c) of Fig. 2, the PAT is an information comprising the transfer control flag, AID_g , AID_1 , and the validity period, which is signed by the ADS 7 using a secret key of the ADS 7. Here, the transfer control flag value is defined to take either 0 or 1. Also, the validity period is defined by any one or combination of the number of times for which the PAT is available, the absolute time (UTC) by which the PAT becomes unavailable, the absolute time (UTC) by which the PAT becomes available, and the relative time (lifetime) since the PAT becomes available until it becomes unavailable.

[0156] Note that, as will be explained in the subsequent embodiments described below, in addition to the 1-to-1 PAT which sets one sender and one recipient in correspondence as described above, the present invention can also use a 1-to-N PAT which sets one sender and N recipients, as well as a link specifying PAT which specifies the AID by a link information that is capable of specifying the AID instead of specifying the AID itself in the PAT. The link specifying PAT can be either a link specifying 1-to-1 PAT or a link specifying 1-to-N PAT depending on the correspondence relationship between the sender and the recipients as described above. Namely, the PAT of the present invention can be given in four types: 1-to-1 PAT, 1-to-N PAT, link specifying 1-to-1 PAT, and link specifying 1-to-N PAT.

[0157] Next, a procedure by which the user 3 requests the AID to the CA 1 will be described. The user 3 generates a pair of a secret key and a public key. Then, the user 3 and the CA 1 carries out the bidirectional authentication using the OID of the user 3 and the certificate of the CA 1, and the user 3 transmits the public key to the CA 1 by arbitrary means. Here, there can be cases where communications between the user 3 and the CA 1 are to be encrypted.

[0158] Next, a procedure by which the CA 1 issues the AID to the user 3 in response to a request for the AID as described above will be described. Upon receiving the public key from the user 3, the CA 1 generates the AID.

5 Then, the CA 1 transmits the AID to the user 3 by arbitrary means. Upon receiving the AID from the CA 1, the user 3 stores the received AID into its storage device. Here, there can be cases where communications between the user 3 and the CA 1 are to be encrypted.

10 [0159] Next, the AID generation processing at the CA will be described with reference to Fig. 3.

[0160] In the procedure of Fig. 3, the CA 1 generates an information of a length equal to the total length L of the OID, and sets this information as a tentative AID (step S911). Then, in order to carry out the partial copying of the OID, values of parameters p_i and ℓ_i for specifying a copying region are determined using arbitrary means such as random number generation respectively (step S913). Here, L is equal to the total length L of the OID, and ℓ_i is an arbitrarily defined value within a range in which a relationship of $0 \leq \ell_i \leq L$ holds. Then, an information in a range between a position p_i to a position $p_i + \ell_i$ from the top of the OID is copied to the same positions in the tentative AID (step S915). In other words,

15 20 this OID fragment will be copies to a range between a position p_i and a position $p_i + \ell_i$ from the top of the tentative AID. Then, the values of p_i and ℓ_i are written into a prescribed range in the tentative AID into which the OID has been partially copied, in a form encrypted by an arbitrary means (step S917). Then, an SCS information given by an arbitrary character string (host name, real domain, etc.) that can uniquely identify a host or a domain that is operating the SCS 5 on the network is written into a prescribed range in the tentative AID into

25 30 which these values are written (step S919). Then, the tentative AID into which the above character string is written is signed using a secret key of the CA 1 (step S921).

[0161] Next, a procedure for registering the AID of a user-B 3 and the disclosed information into the ADS 7 will be described. First, the bidirectional authentication by arbitrary means using the AID of the user-B 3 and the certificate of the ADS 7 is carried out between the user-B 3 who is a registrant and the ADS 7. Then, the user-B

40 45 50 55 60 65 70 75 80 85 90 95 100 105 110 115 120 125 130 135 140 145 150 155 160 165 170 175 180 185 190 195 200 205 210 215 220 225 230 235 240 245 250 255 260 265 270 275 280 285 290 295 300 305 310 315 320 325 330 335 340 345 350 355 360 365 370 375 380 385 390 395 400 405 410 415 420 425 430 435 440 445 450 455 460 465 470 475 480 485 490 495 500 505 510 515 520 525 530 535 540 545 550 555 560 565 570 575 580 585 590 595 600 605 610 615 620 625 630 635 640 645 650 655 660 665 670 675 680 685 690 695 700 705 710 715 720 725 730 735 740 745 750 755 760 765 770 775 780 785 790 795 800 805 810 815 820 825 830 835 840 845 850 855 860 865 870 875 880 885 890 895 900 905 910 915 920 925 930 935 940 945 950 955 960 965 970 975 980 985 990 995 1000 1005 1010 1015 1020 1025 1030 1035 1040 1045 1050 1055 1060 1065 1070 1075 1080 1085 1090 1095 1100 1105 1110 1115 1120 1125 1130 1135 1140 1145 1150 1155 1160 1165 1170 1175 1180 1185 1190 1195 1200 1205 1210 1215 1220 1225 1230 1235 1240 1245 1250 1255 1260 1265 1270 1275 1280 1285 1290 1295 1300 1305 1310 1315 1320 1325 1330 1335 1340 1345 1350 1355 1360 1365 1370 1375 1380 1385 1390 1395 1400 1405 1410 1415 1420 1425 1430 1435 1440 1445 1450 1455 1460 1465 1470 1475 1480 1485 1490 1495 1500 1505 1510 1515 1520 1525 1530 1535 1540 1545 1550 1555 1560 1565 1570 1575 1580 1585 1590 1595 1600 1605 1610 1615 1620 1625 1630 1635 1640 1645 1650 1655 1660 1665 1670 1675 1680 1685 1690 1695 1700 1705 1710 1715 1720 1725 1730 1735 1740 1745 1750 1755 1760 1765 1770 1775 1780 1785 1790 1795 1800 1805 1810 1815 1820 1825 1830 1835 1840 1845 1850 1855 1860 1865 1870 1875 1880 1885 1890 1895 1900 1905 1910 1915 1920 1925 1930 1935 1940 1945 1950 1955 1960 1965 1970 1975 1980 1985 1990 1995 2000 2005 2010 2015 2020 2025 2030 2035 2040 2045 2050 2055 2060 2065 2070 2075 2080 2085 2090 2095 2100 2105 2110 2115 2120 2125 2130 2135 2140 2145 2150 2155 2160 2165 2170 2175 2180 2185 2190 2195 2200 2205 2210 2215 2220 2225 2230 2235 2240 2245 2250 2255 2260 2265 2270 2275 2280 2285 2290 2295 2300 2305 2310 2315 2320 2325 2330 2335 2340 2345 2350 2355 2360 2365 2370 2375 2380 2385 2390 2395 2400 2405 2410 2415 2420 2425 2430 2435 2440 2445 2450 2455 2460 2465 2470 2475 2480 2485 2490 2495 2500 2505 2510 2515 2520 2525 2530 2535 2540 2545 2550 2555 2560 2565 2570 2575 2580 2585 2590 2595 2600 2605 2610 2615 2620 2625 2630 2635 2640 2645 2650 2655 2660 2665 2670 2675 2680 2685 2690 2695 2700 2705 2710 2715 2720 2725 2730 2735 2740 2745 2750 2755 2760 2765 2770 2775 2780 2785 2790 2795 2800 2805 2810 2815 2820 2825 2830 2835 2840 2845 2850 2855 2860 2865 2870 2875 2880 2885 2890 2895 2900 2905 2910 2915 2920 2925 2930 2935 2940 2945 2950 2955 2960 2965 2970 2975 2980 2985 2990 2995 3000 3005 3010 3015 3020 3025 3030 3035 3040 3045 3050 3055 3060 3065 3070 3075 3080 3085 3090 3095 3100 3105 3110 3115 3120 3125 3130 3135 3140 3145 3150 3155 3160 3165 3170 3175 3180 3185 3190 3195 3200 3205 3210 3215 3220 3225 3230 3235 3240 3245 3250 3255 3260 3265 3270 3275 3280 3285 3290 3295 3300 3305 3310 3315 3320 3325 3330 3335 3340 3345 3350 3355 3360 3365 3370 3375 3380 3385 3390 3395 3400 3405 3410 3415 3420 3425 3430 3435 3440 3445 3450 3455 3460 3465 3470 3475 3480 3485 3490 3495 3500 3505 3510 3515 3520 3525 3530 3535 3540 3545 3550 3555 3560 3565 3570 3575 3580 3585 3590 3595 3600 3605 3610 3615 3620 3625 3630 3635 3640 3645 3650 3655 3660 3665 3670 3675 3680 3685 3690 3695 3700 3705 3710 3715 3720 3725 3730 3735 3740 3745 3750 3755 3760 3765 3770 3775 3780 3785 3790 3795 3800 3805 3810 3815 3820 3825 3830 3835 3840 3845 3850 3855 3860 3865 3870 3875 3880 3885 3890 3895 3900 3905 3910 3915 3920 3925 3930 3935 3940 3945 3950 3955 3960 3965 3970 3975 3980 3985 3990 3995 4000 4005 4010 4015 4020 4025 4030 4035 4040 4045 4050 4055 4060 4065 4070 4075 4080 4085 4090 4095 4100 4105 4110 4115 4120 4125 4130 4135 4140 4145 4150 4155 4160 4165 4170 4175 4180 4185 4190 4195 4200 4205 4210 4215 4220 4225 4230 4235 4240 4245 4250 4255 4260 4265 4270 4275 4280 4285 4290 4295 4300 4305 4310 4315 4320 4325 4330 4335 4340 4345 4350 4355 4360 4365 4370 4375 4380 4385 4390 4395 4400 4405 4410 4415 4420 4425 4430 4435 4440 4445 4450 4455 4460 4465 4470 4475 4480 4485 4490 4495 4500 4505 4510 4515 4520 4525 4530 4535 4540 4545 4550 4555 4560 4565 4570 4575 4580 4585 4590 4595 4600 4605 4610 4615 4620 4625 4630 4635 4640 4645 4650 4655 4660 4665 4670 4675 4680 4685 4690 4695 4700 4705 4710 4715 4720 4725 4730 4735 4740 4745 4750 4755 4760 4765 4770 4775 4780 4785 4790 4795 4800 4805 4810 4815 4820 4825 4830 4835 4840 4845 4850 4855 4860 4865 4870 4875 4880 4885 4890 4895 4900 4905 4910 4915 4920 4925 4930 4935 4940 4945 4950 4955 4960 4965 4970 4975 4980 4985 4990 4995 5000 5005 5010 5015 5020 5025 5030 5035 5040 5045 5050 5055 5060 5065 5070 5075 5080 5085 5090 5095 5100 5105 5110 5115 5120 5125 5130 5135 5140 5145 5150 5155 5160 5165 5170 5175 5180 5185 5190 5195 5200 5205 5210 5215 5220 5225 5230 5235 5240 5245 5250 5255 5260 5265 5270 5275 5280 5285 5290 5295 5300 5305 5310 5315 5320 5325 5330 5335 5340 5345 5350 5355 5360 5365 5370 5375 5380 5385 5390 5395 5400 5405 5410 5415 5420 5425 5430 5435 5440 5445 5450 5455 5460 5465 5470 5475 5480 5485 5490 5495 5500 5505 5510 5515 5520 5525 5530 5535 5540 5545 5550 5555 5560 5565 5570 5575 5580 5585 5590 5595 5600 5605 5610 5615 5620 5625 5630 5635 5640 5645 5650 5655 5660 5665 5670 5675 5680 5685 5690 5695 5700 5705 5710 5715 5720 5725 5730 5735 5740 5745 5750 5755 5760 5765 5770 5775 5780 5785 5790 5795 5800 5805 5810 5815 5820 5825 5830 5835 5840 5845 5850 5855 5860 5865 5870 5875 5880 5885 5890 5895 5900 5905 5910 5915 5920 5925 5930 5935 5940 5945 5950 5955 5960 5965 5970 5975 5980 5985 5990 5995 6000 6005 6010 6015 6020 6025 6030 6035 6040 6045 6050 6055 6060 6065 6070 6075 6080 6085 6090 6095 6100 6105 6110 6115 6120 6125 6130 6135 6140 6145 6150 6155 6160 6165 6170 6175 6180 6185 6190 6195 6200 6205 6210 6215 6220 6225 6230 6235 6240 6245 6250 6255 6260 6265 6270 6275 6280 6285 6290 6295 6300 6305 6310 6315 6320 6325 6330 6335 6340 6345 6350 6355 6360 6365 6370 6375 6380 6385 6390 6395 6400 6405 6410 6415 6420 6425 6430 6435 6440 6445 6450 6455 6460 6465 6470 6475 6480 6485 6490 6495 6500 6505 6510 6515 6520 6525 6530 6535 6540 6545 6550 6555 6560 6565 6570 6575 6580 6585 6590 6595 6600 6605 6610 6615 6620 6625 6630 6635 6640 6645 6650 6655 6660 6665 6670 6675 6680 6685 6690 6695 6700 6705 6710 6715 6720 6725 6730 6735 6740 6745 6750 6755 6760 6765 6770 6775 6780 6785 6790 6795 6800 6805 6810 6815 6820 6825 6830 6835 6840 6845 6850 6855 6860 6865 6870 6875 6880 6885 6890 6895 6900 6905 6910 6915 6920 6925 6930 6935 6940 6945 6950 6955 6960 6965 6970 6975 6980 6985 6990 6995 7000 7005 7010 7015 7020 7025 7030 7035 7040 7045 7050 7055 7060 7065 7070 7075 7080 7085 7090 7095 7100 7105 7110 7115 7120 7125 7130 7135 7140 7145 7150 7155 7160 7165 7170 7175 7180 7185 7190 7195 7200 7205 7210 7215 7220 7225 7230 7235 7240 7245 7250 7255 7260 7265 7270 7275 7280 7285 7290 7295 7300 7305 7310 7315 7320 7325 7330 7335 7340 7345 7350 7355 7360 7365 7370 7375 7380 7385 7390 7395 7400 7405 7410 7415 7420 7425 7430 7435 7440 7445 7450 7455 7460 7465 7470 7475 7480 7485 7490 7495 7500 7505 7510 7515 7520 7525 7530 7535 7540 7545 7550 7555 7560 7565 7570 7575 7580 7585 7590 7595 7600 7605 7610 7615 7620 7625 7630 7635 7640 7645 7650 7655 7660 7665 7670 7675 7680 7685 7690 7695 7700 7705 7710 7715 7720 7725 7730 7735 7740 7745 7750 7755 7760 7765 7770 7775 7780 7785 7790 7795 7800 7805 7810 7815 7820 7825 7830 7835 7840 7845 7850 7855 7860 7865 7870 7875 7880 7885 7890 7895 7900 7905 7910 7915 7920 7925 7930 7935 7940 7945 7950 7955 7960 7965 7970 7975 7980 7985 7990 7995 8000 8005 8010 8015 8020 8025 8030 8035 8040 8045 8050 8055 8060 8065 8070 8075 8080 8085 8090 8095 8100 8105 8110 8115 8120 8125 8130 8135 8140 8145 8150 8155 8160 8165 8170 8175 8180 8185 8190 8195 8200 8205 8210 8215 8220 8225 8230 8235 8240 8245 8250 8255 8260 8265 8270 8275 8280 8285 8290 8295 8300 8305 8310 8315 8320 8325 8330 8335 8340 8345 8350 8355 8360 8365 8370 8375 8380 8385 8390 8395 8400 8405 8410 8415 8420 8425 8430 8435 8440 8445 8450 8455 8460 8465 8470 8475 8480 8485 8490 8495 8500 8505 8510 8515 8520 8525 8530 8535 8540 8545 8550 8555 8560 8565 8570 8575 8580 8585 8590 8595 8600 8605 8610 8615 8620 8625 8630 8635 8640 8645 8650 8655 8660 8665 8670 8675 8680 8685 8690 8695 8700 8705 8710 8715 8720 8725 8730 8735 8740 8745 8750 8755 8760 8765 8770 8775 8780 8785 8790 8795 8800 8805 8810 8815 8820 8825 8830 8835 8840 8845 8850 8855 8860 8865 8870 8875 8880 8885 8890 8895 8900 8905 8910 8915 8920 8925 8930 8935 8940 8945 8950 8955 8960 8965 8970 8975 8980 8985 8990 8995 9000 9005 9010 9015 9020 9025 9030 9035 9040 9045 9050 9055 9060 9065 9070 9075 9080 9085 9090 9095 9100 9105 9110 9115 9120 9125 9130 9135 9140 9145 9150 9155 9160 9165 9170 9175 9180 9185 9190 9195 9200 9205 9210 9215 9220 9225 9230 9235 9240 9245 9250 9255 9260 9265 9270 9275 9280 9285 9290 9295 9300 9305 9310 9315 9320 9325 9330 9335 9340 9345 9350 9355 9360 9365 9370 9375 9380 9385 9390 9395 9400 9405 9410 9415 9420 9425 9430 9435 9440 9445 9450 9455 9460 9465 9470 9475 9480 9485 9490 9495 9500 9505 9510 9515 9520 9525 9530 9535 9540 9545 9550 9555 9560 9565 9570 9575 9580 9585 9590 9595 9600 9605 9610 9615 9620 962

ADS 7. Then, the user-A 3 transmits arbitrary search conditions to the ADS 7. Then, the ADS 7 presents all the received search conditions to its storage device, and extracts the AID of a registrant which satisfies these search conditions. Then, the ADS 7 generates the PAT from the AID of the user-A 3, the AID of the registrant who satisfied all the search conditions, the transfer control flag value, and the validity period value. Then, the ADS 7 transmits the generated PAT to the user-A 3. Here, there can be cases where communications between the user-A 3 who is a searcher and the ADS 7 are to be encrypted. Note that the 1-to-1 PAT is generated as a search result of the ADS 7.

[0163] Next, the 1-to-1 PAT generation processing at the ADS 7 will be described with reference to Fig. 4.

[0164] First, an information of a prescribed length is generated, and this information is set as a tentative PAT (step S1210). Then, the AID of the user-A 3 who is a searcher and the AID of the user-B 3 who is a registrant are copied into a prescribed region of the tentative PAT (step S1215). Then, the transfer control flag value and the validity period value are written into respective prescribed regions of the tentative PAT into which the AIDs are copied (step S1217). Then, the tentative PAT into which these values are written is signed using a secret key of the ADS 7 (step S1219).

[0165] Next, the transfer control using the 1-to-1 PAT will be described. The transfer control is a function for limiting accesses to a user who has a proper access right from a third person to whom the PAT has been transferred or who has eavesdropped the PAT (a user who originally does not have the access right).

[0166] The ADS 7 and the user-B 3 of the registrant AID can prohibit a connection to the user-B 3 from a third person who does not have the access right, by setting a certain value in to the transfer control flag of the PAT.

[0167] When the transfer control flag value is set to be 1, the sender's AID is authenticated between the SCS 5 and the sender according to an arbitrary challenge/response process, so that even if the sender gives both the sender's AID and the PAT to another user other than the sender, that another user will not be able to make a connection to the registrant of the ADS 7 through the SCS 5.

[0168] On the other hand, when the transfer control flag value is set to be 0, no challenge/response process will be carried out between the SCS 5 and the sender, so that if the sender gives both the sender's AID and the PAT to another user other than the sender, that another user will also be able to make a connection to the registrant of the ADS 7 through the SCS 5.

[0169] Next, the email access control method at the SCS 5 will be described with reference to Fig. 5.

[0170] The sender specifies "[sender's AID]@[real domain of SCS of sender]" in From: line, and "[PAT]@[real domain of SCS of sender]" in To: line.

[0171] The SCS 5 acquires a mail received by an MTA

(Message Transfer Agent) such as SMTP (Simple Mail Transfer Protocol), and executes the processing of Fig. 5 as follows.

5 (1) The signature of the PAT is verified using a public key of the ADS 7 (step S1413).

When the PAT is found to have been altered (step S1415 YES), the mail is discarded and the processing is terminated (step S1416).

10 When the PAT is found to have been not altered (step S1415 NO), the following processing (2) is executed.

(2) The search is carried out by presenting the sender's AID to the PAT (steps S1417, S1419, S1421).

15 When an AID that completely matches with the sender's AID is not contained in the PAT (step S1423 NO), the mail is discarded and the processing is terminated (step S1416).

20 When an AID that completely matches with the sender's AID is contained in the PAT (step S1423 YES), the following processing (3) is executed.

(3) The validity period value of the PAT is evaluated (steps S1425, S1427).

25 When the PAT is outside the validity period (step S1427 NO), the mail is discarded and the processing is terminated (step S1416).

30 When the PAT is within the validity period (step S1427 YES), the following processing (4) is executed.

(4) Whether or not to authenticate the sender is determined by referring to the transfer control flag value of the PAT (steps S1431, S1433).

35 When the value is 1 (step S1433 YES), the challenge/response authentication between the SCS 5 and the sender is carried out, and the signature of the sender is verified (step S1435). When the signature is valid, the recipient is specified and the PAT is attached (step S1437). When the signature is invalid, the mail is discarded and the processing is terminated (step S1416).

40 When the value is 0 (step S1433 NO), the recipient is specified and the PAT is attached without executing the challenge/response authentication (step S1437).

45 [0172] Next, an exemplary challenge/response authentication between the SCS 5 and the sender will be described.

50 [0173] First, the SCS 5 generates an arbitrary information such as a timestamp, for example, and transmits the generated information to the sender.

[0174] Then, the sender signs the received information using a secret key of the sender's AID and transmits it along with a public key of the sender's AID.

[0175] The SCS 5 then verifies the signature of the received information using the public key of the sender's AID. When the signature is valid, the recipient is speci-

fied and the PAT is attached. When the signature is invalid, the mail is discarded and the processing is terminated.

[0176] Next, a method for specifying the recipient at the SCS 5 will be described. First, the SCS 5 carries out the search by presenting the sender's AID to the PAT, so as to acquire all the AIDs which do not completely match the sender's AID. All these acquired AIDs will be defined as recipient's AIDs hereafter. Then, for every recipient's AID, the real domain of SCS of recipient is taken out from the recipient's AID. Then, the recipient is specified in a format of "[recipient's AID]@[real domain of SCS of recipient]". Finally, the SCS 5 changes the sender from a format of "[sender's AID]@[real domain of SCS of sender]" to a format of "sender's AID".

[0177] Next, a method for attaching the PAT at the SCS 5 will be described. The SCS 5 attaches the PAT to an arbitrary position in the mail. The SCS 5 gives the mail to the MTA after specifying the sender and the recipient and attaching the PAT.

[0178] Note that all the processings described above are the same in the case of the 1-to-N PAT.

[0179] Next, a method of receiving refusal with respect to the PAT at the SCS 5 will be described.

[0180] Receiving refusal setting: The bidirectional authentication is carried out by an arbitrary means between the user and the SCS 5. Then, the user transmits a registration command, his/her own AID, and arbitrary PATs to the SCS 5. Then, the SCS 5 verifies the signature of the received AID. If the signature is invalid, the processing of the SCS 5 is terminated. If the signature is valid, the SCS 5 next verifies the signature of each received PAT using a public key of the ADS. Those PATs with the invalid signature are discarded by the SCS 5. When the signature is valid, the SCS 5 carries out the search by presenting the received AID to each PAT. For each of those PATs which contain the AID that completely matches with the received AID, the SCS 5 presents the registration command and the PAT to the storage device such that the PAT is registered into the storage device. Those PATs which do not contain the AID that completely matches with the received AID are discarded by the SCS 5 without storing them into the storage device. Here, there can be cases where communications between the user and the SCS 5 are to be encrypted.

[0181] Receiving refusal execution: The SCS 5 carries out the search by presenting the PAT to the storage device. When a PAT that completely matches the presented PAT is registered in the storage device, the mail is discarded. When a PAT that completely matches the present PAT is not registered in the storage device, the mail is not discarded.

[0182] Receiving refusal cancellation: The bidirectional authentication is carried out by an arbitrary means between the user and the SCS 5. Then, the user presents his/her own AID to the SCS 5. Then, the SCS 5 verifies the signature of the received AID. If the signa-

ture is invalid, the processing of the SCS 5 is terminated. If the signature is valid, the SCS 5 next presents the presented AID as a search condition to the storage device and acquire all the PATs that contain the presented AID, and then presents all the acquired PATs to the user. Then, the user selects all the PATs for which the receiving refusal is to be cancelled by referring to all the PATs presented from the SCS 5, and transmits all the selected PATs along with a deletion command to the SCS 5. Upon receiving the deletion command and all the PATs for which the receiving refusal is to be cancelled, the SCS 5 presents the deletion command and all the PATs received from the user to the storage device, such that all the received PATs are deleted from the storage device.

[0183] Note that the method of receiving refusal with respect to the 1-to-N PAT at the SCS 5 is the same as the method of receiving refusal with respect to the 1-to-1 PAT described above.

[0184] Note also the the case of returning of a mail from the user-B to the user-A is the same as in the case of transmitting a mail from the user-A to the user-B.

[0185] Next, the judgement of identity will be described with reference to Fig. 6 and Fig. 7.

(1) An initial value of a variable OID_M is defined as a bit sequence with a length equal to the total length L of the OID and all values equal to "0". Also, an initial value of a variable OID_V is defined as a bit sequence with a length equal to the total length of the OID and all values equal to "0" (step S2511).
(2) One AID is selected from a set of processing target AIDs, and the following bit processing is carried out (step S2513).

(a) Values of variables AID_M and AID_V are determined according to the position information contained in the AID (step S2515). Here, AID_M is defined as a bit sequence with a length equal to the total length L of the OID and a value of a position at which the OID information is defined is "1" while a value of a position at which the OID information is not defined is "0" (see Fig. 7). Also, AID_V is defined as a bit sequence with a length equal to the total length L of the OID and a value of a position at which the OID information is defined is an actual value of the OID information while a value of a position at which the OID information is not defined is 0 (see Fig. 7).

(b) AND processing of OID_M and AID_M is carried out and its result is substituted into a variable OVR_M (step S2517).

(c) AND processing of OVR_M and AID_M as well as AND processing of OVR_M and OID_M are carried out and their results are compared (step S2519). When they coincide, OR processing of OID_M and AID_M is carried out

and its result is substituted into OID_M (step S2521), while OR processing of OID_V and AID_V is also carried out and its result is substituted into OID_M (step S2523). On the other hand, when they do not coincide, the processing proceeds to the step S2525.

(d) An AID to be processed next is selected from a set of processing target AIDs. When at least one another AID is contained in the set, the steps S2513 to S2523 are executed for that another AID. When no other AID is contained in the set, the processing proceeds to the step S2527.

(e) Values of OID_M and OID_V are outputted (step S2527).

[0186] The value of OID_M that is eventually obtained indicates all positions of the OID information that can be recovered from the set of processing target AIDs. Also, the value of OID_V that is eventually obtained indicates all the OID information that can be recovered from the set of processing target AID. In other words, by using the values of OID_M and OID_V , it is possible to obtain the OID albeit probabilistically when the value of OID_V is used as a search condition, and it is possible to quantitatively evaluate a precision of the above search by a ratio OID_M/L with respect to the total length L of the OID.

[0187] As described above, in this first embodiment, the CA 1 which is a Trusted Third Party with high secrecy and credibility generates the AID in which the personal information is concealed, from the OID that contains the highly secret personal information such as name, telephone number, real email address, etc., according to a user request, and issues the AID to the user. By identifying the user by this AID on the communication network as well as in various services provided on the communication network, it becomes possible to provide both the anonymity guarantee and the identity guarantee for the user. In other words, it becomes possible for the user to communicate with another user without revealing the own real name, telephone number, email address, etc., to that another user, and it also becomes possible to disclose the disclosed information to unspecified many through the ADS 7 as will be described below.

[0188] The user registers the disclosed information, that is an information which is supposed to have a low secrecy compared with the personal information at the ADS 7. In the case of searching the disclosed information and the registrant AID, the searcher presents the AID of the searcher and arbitrary search conditions to the ADS 7. The ADS 7 then extracts the registrant AID that satisfies these search conditions, and generates the PAT from the AID of the searcher and the AID of the registrant who satisfied the search conditions, the transfer control flag value, and the validity period value.

[0189] In this 1-to-1 PAT, the transfer control flag value and the validity period value are set as shown a part (c)

of Fig. 2, and by setting up this validity period in advance, it is possible to limit connections from the sender.

[0190] It is also possible to prohibit connections from a third person who does not have the access right, by using the transfer control flag value. Namely, when the transfer control flag value is set to be 1, the sender's AID is authenticated between the SCS 5 and the sender according to an arbitrary challenge/response process, so that even if the sender gives both the sender's AID and the PAT to another user other than the sender, that another user will not be able to make a connection to the registrant of the ADS 7 through the SCS 5. On the other hand, when the transfer control flag value is set to be 0, no challenge/response process will be carried out between the SCS 5 and the sender, so that if the sender gives both the sender's AID and the PAT to another user other than the sender, that another user will also be able to make a connection to the registrant of the ADS 7 through the SCS 5.

[0191] It is also possible to make a connection request to the communication network such that a call for which the recipient is specified by the 1-to-1 PAT will be received by the recipient's AID or the sender's AID defined within the PAT. In addition, it is also possible to refuse receiving calls with the 1-to-1 PAT selected by the recipient among calls which are specified by the 1-to-1 PAT. It is also possible to cancel the receiving refusal of the calls with the 1-to-1 PAT selected by the recipient. In addition, as a measure against the sender who repeats the personal attach using a plurality of sender's AIDs by taking an advantage of the anonymity, it is possible to judge the identity of the OID from these plurality of sender's AIDs and it is possible to extract that OID at some probability.

[0192] Next, with references to Fig. 8 to Fig. 24, the second embodiment of the email access control scheme according to the present invention will be described in detail.

[0193] In contrast to the first embodiment described above which is directed to the case where a sender and a recipient are set in 1-to-1 correspondence, this second embodiment is directed to the case where a sender and recipients are set in 1-to-N correspondence and a generation of a new PAT and a content change of the existing PAT can be made by the initiative of a user. Here, the sender is either a holder of the PAT or a member of the PAT. Similarly, the recipient is either a holder of the PAT or a member of the PAT.

[0194] In general, a membership of a group communication (mailing list, etc.) is changing dynamically so that it is necessary for a host of the group communication to manage information on a point of contact such as telephone number, email address, etc., of each member. In contrast, in the case where it is only possible to newly generate a 1-to-1 PAT as in the first embodiment, the management of a point of contact is difficult. For example, it is difficult to manage the group collectively, and

even if it is given to the others for the purpose of the transfer control, it does not function as an address of the group communication such as mailing list.

[0195] In this second embodiment, in order to resolve such a problem, it is made possible to carry out a generation of a new 1-to-N PAT and a content change of the existing 1-to-N PAT by the initiative of a user.

[0196] First, the definition of various identifications used in this second embodiment will be described with references to Fig. 8 and Fig. 9.

[0197] As shown in a part (a) of Fig. 8, the OID is an information comprising an arbitrary character string (telephone number, email address, etc.) according to a rule by which the CA 1 can uniquely identify the user and a public key, which is signed by the CA 1.

[0198] Also, as shown in a part (b) of Fig. 8, the AID is an information comprising fragments of the OID and their position information, redundant character strings, and an SCS information given by an arbitrary character string (host name, real domain name, etc.) by which a host or a domain that is operating the SCS 5 can be uniquely identified on the network, which is signed by the CA 1.

[0199] Also, as shown in a part (c) of Fig. 8, the 1-to-N PAT is an information comprising two or more AIDs, a holder index, the validity period, the transfer control flag, and a PAT processing device identifier, which is signed using a secret key of the PAT processing device.

[0200] Here, one of the AIDs is a holder AID of this PAT, where the change of the information contained in the PAT such as an addition of AID to the PAT, a deletion of AID from the PAT, a change of the validity period in the PAT, a change of the transfer control flag value in the PAT, etc., can be made by presenting the holder AID and a corresponding Enabler to the PAT processing device.

[0201] On the other hand, the AIDs other than the holder AID that are contained in the PAT are all member AIDs, where a change of the information contained in the PAT cannot be made even when the member AID and a corresponding Enabler are presented to the PAT processing device.

[0202] The holder index is a numerical data for identifying the holder AID, which is defined to take a value 1 when the holder AID is a top AID in the AID list formed from the holder AID and the member AIDs, a value 2 when the holder AID is a second AID from the top of the AID list, or a value n when the holder AID is an n-th AID from the top of the AID list.

[0203] The transfer control flag value is defined to take either 0 or 1 similarly as in the case of the 1-to-1 PAT.

[0204] The holder AID is defined to be an AID which is written at a position of the holder index value in the AID list. The member AIDs are defined to be all the AIDs other than the holder AID.

[0205] The validity period is defined by any one or combination of the number of times for which the PAT is available, the absolute time (UTC) by which the PAT

becomes unavailable, the absolute time (UTC) by which the PAT becomes available, and the relative time (lifetime) since the PAT becomes available until it becomes unavailable.

5 [0206] The identifier of a PAT processing device (or a PAT processing object on the network) is defined as a serial number of the PAT processing device (or an distinguished name of the PAT processing object on the network). The secret key of the PAT processing device (or the PAT processing object on the network) is defined to be uniquely corresponding to the identifier.

10 [0207] Also, in this second embodiment, an Enabler is introduced as an identifier corresponding to the AID. As shown in Fig. 9, the Enabler is an information comprising a character string uniquely indicating that it is an Enabler and an AID itself, which is signed by the CA 1.

15 [0208] Next, the operations for a generation of a new PAT and a content change of the existing PAT will be described. Here, the following operations are defined at a secure PAT processing device on the communication terminal or a PAT processing object on the CA or on a network which is properly requested from the CA (which will also be referred to as a PAT processing device hereafter).

20 25 1. Editing of AID list:
A list of AIDs (referred hereafter as an AID list) contained in the PAT is edited using AIDs and Enabler. Else, the AID list is newly generated.

30 35 2. Setting of the validity period and the transfer control flag:
The validity period value and the transfer control flag value contained in the PAT are changed using an AID and Enabler. Also, a new validity period value and a new transfer control flag value are set in the newly generated AID list.

40 [0209] A user who presented the holder AID and the Enabler corresponding to this holder AID to the PAT processing device can edit the list of AIDs contained in the PAT. In this case, the following processing rules are used.

45 (1) Generating a new PAT (MakePAT) (see Fig. 10):
The AID list (ALIST<holder AID | member AID₁, member AID₂, ··· ··· ··· , member AID_n>) is newly generated, and the validity period value and the transfer control flag value are set with respect to the generated ALIST.

50 AID_A + AID_B + Enabler of AID_B + Enabler of AID_A

55 → ALIST<AID_A | AID_B>

ALIST<AID_A | AID_B> + Enabler of AID_A

+ validity period value

+ transfer control flag value
 $\rightarrow \text{PAT} < \text{AID}_A | \text{AID}_B >$

(2) Merging PATs (MergePAT) (see Fig. 11):
 A plurality of ALISTS of the same holder AID are merged and the validity period value and the transfer control flag value are set with respect to the merged ALIST.

5

$\text{ALIST} < \text{AID}_A | \text{AID}_{B1}, \text{AID}_{B2}, \dots \dots \dots >$
 $+ \text{ALIST} < \text{AID}_A | \text{AID}_{C1}, \text{AID}_{C2}, \dots \dots \dots >$
 $+ \text{Enabler of AID}_A$
 $\rightarrow \text{ALIST} < \text{AID}_A | \text{AID}_{B1}, \text{AID}_{B2}, \dots \dots \dots, \text{AID}_{C1}, \text{AID}_{C2}, \dots \dots \dots >$
 $\text{ALIST} < \text{AID}_A | \text{AID}_{B1}, \text{AID}_{B2}, \dots \dots \dots, \text{AID}_{C1}, \text{AID}_{C2}, \dots \dots \dots >$
 $+ \text{Enabler of AID}_A + \text{validity period value}$
 $+ \text{transfer control flag value}$
 $\rightarrow \text{PAT} < \text{AID}_A | \text{AID}_{B1}, \text{AID}_{B2}, \dots \dots \dots, \text{AID}_{C1}, \text{AID}_{C2}, \dots \dots \dots >$

10

15

20

25

30

35

40

45

50

$\text{ALIST} < \text{AID}_A | \text{AID}_B > + \text{ALIST} < \text{AID}_A | \text{AID}_{C1}, \text{AID}_{C2}, \dots \dots \dots >$
 $+ \text{Enabler of AID}_A + \text{validity period value}$
 $+ \text{transfer control flag value}$
 $\rightarrow \text{ALIST} < \text{AID}_B | \text{AID}_{C1}, \text{AID}_{C2}, \dots \dots \dots >$
 $\text{ALIST} < \text{AID}_B | \text{AID}_{C1}, \text{AID}_{C2}, \dots \dots \dots >$
 $+ \text{Enabler of AID}_B + \text{validity period value}$
 $+ \text{transfer control flag value}$
 $\rightarrow \text{PAT} < \text{AID}_B | \text{AID}_{C1}, \text{AID}_{C2}, \dots \dots \dots >$

[0210] In the operation for setting the validity period value, in order to permit the setting of the validity period value only to a user who holds both the holder AID and the corresponding Enabler, the following operation is defined.

$\text{PAT} < \text{AID}_A | \text{AID}_B > + \text{Enabler of AID}_A$
 $+ \text{validity period value}$
 $\rightarrow \text{PAT} < \text{AID}_A | \text{AID}_B >$

[0211] In the operation for setting the transfer control flag value, in order to permit the setting of the transfer control flag value only to a user who holds both the holder AID and the corresponding Enabler, the following operation is defined.

$\text{PAT} < \text{AID}_A | \text{AID}_B > + \text{Enabler of AID}_A$
 $+ \text{transfer control flag value}$
 $\rightarrow \text{PAT} < \text{AID}_A | \text{AID}_B >$

[0212] Next, with references to Fig. 14 to Fig. 20, the overall system configuration of this second embodiment will be described. In Fig. 14 to Fig. 20, the user-A who has AID_A allocated from the CA stores AID_A and Enabler of AID_A in a computer of the user-A, and the input/output devices such as floppy disk drive, CD-ROM drive, communication board, microphone, speaker, etc., are connected. Else, AID_A and Enabler of AID_A are stored in a communication terminal (telephone, cellular phone, etc.) which has a storage device and a data input/output function.

[0213] Similarly, the user-B who has AID_B allocated from the CA stores AID_B and Enabler of AID_B in a computer of the user-B, and the input/output devices such as floppy disk drive, CD-ROM drive, communication board, microphone, speaker, etc., are connected. Else, AID_B and Enabler of AID_B are stored in a communication terminal (telephone, cellular phone, etc.) which has

(3) Splitting a PAT (SplitPAT) (see Fig. 12):
 The ALIST is split into a plurality of ALISTS of the same holder AID, and the respective validity period value and transfer control flag value are set with respect to each one of the split ALISTS.

$\text{ALIST} < \text{AID}_A | \text{AID}_{B1}, \text{AID}_{B2}, \dots \dots \dots, \text{AID}_{C1}, \text{AID}_{C2}, \dots \dots \dots >$
 $+ \text{Enabler of AID}_A$
 $\rightarrow \text{ALIST} < \text{AID}_A | \text{AID}_{B1}, \text{AID}_{B2}, \dots \dots \dots >$
 $+ \text{ALIST} < \text{AID}_A | \text{AID}_{C1}, \text{AID}_{C2}, \dots \dots \dots >$
 $\text{ALIST} < \text{AID}_A | \text{AID}_{C1}, \text{AID}_{C2}, \dots \dots \dots >$
 $+ \text{Enabler of AID}_A + \text{validity period value}$
 $+ \text{transfer control flag value}$
 $\rightarrow \text{PAT} < \text{AID}_A | \text{AID}_{C1}, \text{AID}_{C2}, \dots \dots \dots >$

40

45

50

(4) Changing a holder of a PAT (TransPAT) (see Fig. 13):
 The holder AID of the ALIST is changed, and the validity period value and the transfer control flag value are set with respect to the changed ALIST.

$\rightarrow \text{PAT} < \text{AID}_B | \text{AID}_{C1}, \text{AID}_{C2}, \dots \dots \dots >$

55

a storage device and a data input/output function.

[0214] In the following, a procedure by which the user-A generates PAT<AID_A | AID_B> will be described.

(1) The user-A acquires AID_B and Enabler of AID_B using any of the following means. 5

- AID_B and Enabler of AID_B are registered at the ADS 7, and it is waited until the user-A acquires them as a search result (Fig. 14). 10
- AID_B and Enabler of AID_B are directly transmitted to the user-A by the email, signaling, etc. (Figs. 15, 16).
- AID_B and Enabler of AID_B are stored in a magnetic, optic, or electronic medium such as floppy disk, CD-ROM, MO, IC card, etc., and this medium is given to the user-A. Else, it is waited until the user acquires them by reading this medium (Figs. 17, 18). 15
- AID_B and Enabler of AID_B are printed on a paper medium such as book, name card, etc., and this medium is given to the user-A. Else, it is waited until the user-A acquire them by reading this medium (Figs. 19, 20). 20

(2) The user-A who has acquired AID_B and Enabler of AID_B by any of the means described in the above (1) issues the MakePAT command to the PAT processing device. This procedure is common to Fig. 14 to Fig. 20, and defined as follows. 25

(a) The user-A requests the issuance of the MakePAT command by setting AID_A, Enabler of AID_A, AID_B, Enabler of AID_B, the validity period value, and the transfer control flag value into the communication terminal of the user-A. 30

(b) The communication terminal of the user-A generates the MakePAT command.

(c) The communication terminal of the user-A transmits the generated MakePAT command to the PAT processing device by means such as the email, signaling, etc. (the issuance of the MakePAT command).

(d) The PAT processing device generates PAT<AID_A | AID_B> by processing the received MakePAT command according to Fig. 21 and Fig. 23. More specifically, this is done as follows. 45

AID_A + AID_B + Enabler of AID_B + Enabler of AID_A 50

→ ALIST<AID_A | AID_B>

ALIST<AID_A | AID_B> + Enabler of AID_A 55

+ validity period value + transfer control flag value

→ PAT<AID_A | AID_B>

(e) The PAT processing device transmits the generated PAT<AID_A | AID_B> to the communication terminal of the user-A, or to the communication terminal of the user-B according to the need, by means such as the email, signaling, etc.

(f) The communication terminal of the user-A (or the user-B) stores the received PAT<AID_A | AID_B> in the storage device of the communication terminal of the user-A.

[0215] The merging of PATs (MergePAT, Fig. 21, Fig. 23), the splitting of a PAT (SplitPAT, Fig. 22, Fig. 23), and the changing of a holder of a PAT (TransPAT, Fig. 21, Fig. 23) are also carried out by the similar procedure.

[0216] Next, the procedure of MakePAT, MergePAT and TransPAT will be described with reference to Fig. 21.

(1) The holder AID is specified (step S4411).

(2) All the member AIDs are specified (step S4412).

(3) The AID list is generated from the specified holder AID and all the specified member AIDs (step S4413). More specifically, the specified holder AID and all the specified member AIDs are concatenated using arbitrary means.

(4) A tentative PAT is generated using arbitrary means, similarly as in the case of a tentative AID (step S4414).

(5) The generated AID list is copied to a prescribed region of the generated tentative PAT (step S4415).

(6) The holder index value is written into the tentative pat to which the AID list has been copied (step S4416).

(7) The transfer control flag value is written into the tentative PAT into which the holder index value has been written (step S4417).

(8) The validity period value is written into the tentative PAT into which the transfer control flag value has been written (step S4418).

(9) The PAT processing device identifier is written into the tentative PAT into which the validity period value has been written (step S4419).

(10) The tentative PAT into which the PAT processing device identifier has been written is signed using the secret key of the PAT processing device (step S4420).

[0217] Next, the procedure of SplitPAT will be described with reference to Fig. 22.

(1) The holder AID is specified (step S4511).

(2) All the AIDs to be the member AIDs of the PATs after the splitting are specified (step S4512).

(3) The AID list is generated from the specified holder AID and all the specified member AIDs (step

S4513). More specifically, the specified holder AID and all the specified member AIDs are concatenated using arbitrary means.

(4) A tentative PAT is generated using arbitrary means, similarly as in the case of a tentative AID (step S4514).

(5) The generated AID list is copied to a prescribed region of the generated tentative PAT (step S4515).

(6) The holder index value is written into the tentative pat to which the AID list has been copied (step S4516).

(7) The transfer control flag value is written into the tentative PAT into which the holder index value has been written (step S4517).

(8) The validity period value is written into the tentative PAT into which the transfer control flag value has been written (step S4518).

(9) The PAT processing device identifier is written into the tentative PAT into which the validity period value has been written (step S4519).

(10) The tentative PAT into which the PAT processing device identifier has been written is signed using the secret key of the PAT processing device (step S4520).

(11) In the case of continuing the splitting (step S4521 YES), the procedure returns to (2), and repeats (2) to (10) sequentially.

[0218] Note that, in the procedures of Fig. 21 and Fig. 22, the AID list generation is carried out according to Fig. 23 as follows. Namely, a buffer length is determined first (step S4611) and a buffer is generated (step S4612). Then, the holder AID is copied to a vacant region of the generated buffer (step S4613). Then, the member AID is copied to a vacant region of the resulting buffer (step S4614), and if the next member AID exists (step S4615 YES), the step S4614 is repeated.

[0219] Next, the determination of the holder AID will be described. Each of the MakePAT, the MergePAT, the SplitPAT, and the TransPAT commands is defined to have two or more arguments, where AID, PAT, or Enabler can be specified as an argument. In this case, the PAT processing device specifies the holder AID of the PAT to be outputted after executing each command according to the following rules.

* Case of the MakePAT:

For the MakePAT command, it is defined that AIDs are to be specified for the first argument to the N-th argument ($N = 2, 3, \dots$) and Enablers are to be specified for the N+1-th and subsequent arguments. For example, they can be specified as follows.

MakePAT AID₁, AID₂, ..., AID_N,
Enabler of AID₁, Enabler of AID₂, Enabler of
AID_N

The PAT processing device interprets the AID of the first argument of the MakePAT command as the holder AID.

Only when one of the Enablers of the N+1-th and subsequent arguments corresponds to the AID of the first argument, the PAT processing device specifies this AID (that is the AID of the first argument) as the holder AID of the PAT to be outputted after executing the MakePAT command.

Case of the MergePAT:

For the MergePAT command, it is defined that PATs are to be specified for the first argument to the N-th argument ($N = 2, 3, \dots$) and Enabler is to be specified for the N+1-th argument. Namely, they can be specified as follows.

MergePAT PAT₁, PAT₂, ..., PAT_N, Enabler of AID

The PAT processing device interprets the holder AID of the PAT of the first argument of the MergePAT command as the holder AID of the PAT to be outputted after executing the MergePAT command.

Only when the Enabler of the N+1-th argument corresponds to the holder AID of the PAT of the first argument, the PAT processing device specifies this AID (that is the holder AID of the PAT of the first argument) as the holder AID of the PAT to be outputted after executing the MergePAT command.

Case of the SplitPAT:

For the SplitPAT command, it is defined that PAT is to be specified for the first argument, a set of one or more AIDs grouped together by some prescribed symbols (assumed to be parentheses () in this example) are to be specified for the second argument to the N-th argument ($N = 3, 4, \dots$), and Enabler is to be specified for the N+1-th argument. Namely, they can be specified as follows.

SplitPAT PAT₁ (AID₁₁) (AID₂₁ AID₂₂)
..... (AID_{N1} AID_{N2} ...) AID_{NM}, Enabler of AID

The PAT processing device interprets the holder AID of the PAT of the first argument of the SplitPAT command as the holder AID of the PAT to be outputted after executing the SplitPAT command.

Only when the Enabler of the N+1-th argument corresponds to the holder AID of the PAT of the first argument, the PAT processing device specifies this AID (that is the holder AID of the PAT of the first argument) as the holder AID of the PAT to be outputted after executing the SplitPAT command.

Case of the TransPAT:

For the TransPAT command, it is defined that

PATs are to be specified for the first argument and the second argument, AID is to be specified for the third argument, and Enablers are to be specified for the fourth argument and the fifth argument. Namely, they can be specified as follows.

TransPAT PAT₁ PAT₂ AID Enabler of AID₁, Enabler of AID₂

The PAT processing device interprets the AID of the third argument as the holder AID of the PAT to be outputted after executing the TransPAT command provided that the AID of the third argument of the TransPAT command is contained in the PAT of the second argument.

Only when the Enabler of the fourth argument corresponds to both the PAT of the first argument and the PAT of the second argument and the Enabler of the fifth argument corresponds to the AID of the third argument, the PAT processing device specifies the AID of the third argument as the holder AID of the PAT to be outputted after executing the TransPAT command.

Next, the determination of the member AIDs will be described. The definitions of the MakePAT, the MergePAT, the SplitPAT, and the TransPAT commands are as described above. The PAT processing device specifies the member AIDs of the PAT to be outputted after executing each command according to the following rules.

Case of the MakePAT:

Only when the holder AID of the PAT to be outputted after executing the MakePAT command is formally determined, the PAT processing device interprets all the AIDs of the second and subsequent arguments of the MakePAT command as the member AIDs of the PAT to be outputted after executing the MakePAT command.

The PAT processing device specifies only those AIDs among all the AIDs of the second and subsequent arguments which correspond to the Enablers specified by the N+1-th and subsequent arguments as the member AIDs of the PAT to be outputted after executing the MakePAT command.

Case of the MergePAT:

Only when the holder AID of the PAT to be outputted after executing the MergePAT command is formally determined, the PAT processing device specifies the member AIDs of all the PATs specified by the first to N-th arguments of the MergePAT as the member AIDs of the PAT to be outputted after executing the MergePAT command.

Case of the SplitPAT:

Only when the holder AID of the PAT to be outputted after executing the SplitPAT command is formally determined, the PAT processing device specifies the member AID of the PAT specified by the first argument of the SplitPAT command as the

member AID of the PAT to be outputted after executing the SplitPAT command. At this point, the member AIDs are distributed into different PATs in units of parentheses (). For example, in the case of:

SplitPAT PAT (AID₁₁) (AID₂₁ AID₂₂)
..... (AID_{N1} AID_{N2})
AID_{NM}) Enabler of AID

10 (AID₁₁), (AID₂₁ AID₂₂) and (AID_{N1} AID_{N2} AID_{NM}) will be the member AIDs of different PATs having a common holder AID.

* Case of TransPAT:

Only when the holder AID of the PAT to be outputted after executing the TransPAT command is formally determined, the PAT processing device specifies all the member AIDs remaining after excluding the member AID that is scheduled to be a new holder AID from all the member AIDs of the PAT specified by the first argument of the TransPAT command and the member AIDs of the PAT specified by the second argument as the member AIDs of the PAT to be outputted after executing the TransPAT command.

25

[0220] Next, the verification of the properness of the Enabler will be described. This verification of the properness of the Enabler is common to the MakePAT, the MergePAT, the SplitPAT and the TransPAT, and carried out according to Fig. 24 as follows.

30

(1) AID and Enabler are entered (step S5511).
(2) Each of these entered AID and Enabler is verified using the public key of the CA 1 (step S5512). If at least one of them is altered (step S5513 YES), the processing is terminated.

(3) A character string for certifying that it is Enabler is entered (step S5514).
(4) The top field of the Enabler of the step S5511 and the character string of the step S5514 are compared (step S5515). If they do not match (step S5516 NO), the processing is terminated.
(5) If they match (step S5516 YES), the AID of the step S5511 and the AID within the Enabler are compared (step S5517).

(6) A comparison result is outputted (step S5519).

40 [0221] Next, with references to Fig. 25 to Fig. 28, the third embodiment of the email access control scheme according to the present invention will be described in detail.

50 [0222] In the generation of a new PAT (MakePAT) and the PAT holder change (TransPAT) of the above described embodiment, it is necessary to give member AIDs and Enablers of member AIDs to the holder of the PAT, but when they are given to the holder, it becomes possible for that holder to participate the group communications hosted by the other holders by using the

acquired member AIDs. Namely, there arises a problem that the pretending using the member AIDs become possible. Moreover, if that holder places the acquired member AIDs and Enablers of member AIDs on a medium that is readable by unspecified many, these member AIDs become accessible to anyone so that there arises a problem that the harassment to the users of the member AIDs may occur and the pretending using the member AIDs by a third person also become possible.

[0223] For this reason, in this third embodiment, it is made possible to carry out the MakePAT and the Trans-PAT without giving the Enablers of member AIDs to the holder.

[0224] To this end, in this third embodiment, the generation of a new PAT and the content change of the existing PAT are carried out by using Null-AID (AID_{Null}) and Enabler of Null-AID (Enabler of AID_{Null}).

[0225] Here, the processing involving the Null-AID obeys all of the following rules:

(a) the processing rules of MakePAT, MergePAT, SplitPAT and TransPAT as in the above described embodiment; and

(b) the rules applicable only to the Null-AID, including:

- (i) Null-AID is known to every user, and
- (ii) Enabler of Null-AID is known to every user.

[0226] Here, the processing rules as defined in the above described embodiment in the case of this third embodiment will be described.

(1) Making a PAT from plural AIDs (MakePAT):

$AID_{holder} + AID_{member1} + AID_{member2} + \dots + AID_{memberN}$

+ Enabler of $AID_{member1}$ + Enabler of $AID_{member2} + \dots +$

+ Enabler of $AID_{memberN}$ + Enabler of AID_{holder}

$\rightarrow PAT<AID_{holder} | AID_{member1}, AID_{member2}, \dots, AID_{memberN}>$

(2) Merging plural PATs of the same holder (Merge-PAT):

$PAT<AID_{holder} | AID_{member1}, AID_{member2}, \dots, AID_{memberM}>$

+ $PAT<AID_{holder} | AID_{member1}, AID_{member2}, \dots, AID_{memberN}>$

+ Enabler of AID_{holder}

$\rightarrow PAT<AID_{holder} | AID_{member1}, AID_{member2}, \dots, AID_{memberM}, AID_{member1}, AID_{member2}, \dots, AID_{memberN}>$

5 (3) Splitting a PAT into plural PATs of the same holder (SplitPAT):

$PAT<AID_{holder} | AID_{member1}, AID_{member2}, \dots, AID_{memberM}, AID_{member1}, AID_{member2}, \dots, AID_{memberN}>$

+ Enabler of AID_{holder}

$\rightarrow PAT<AID_{holder} | AID_{member1}, AID_{member2}, \dots, AID_{memberM}>$

+ $PAT<AID_{holder} | AID_{member1}, AID_{member2}, \dots, AID_{memberN}>$

10 (4) Changing a holder AID of a PAT (TransPAT):

$PAT<AID_{holder} | AID_{member1}, AID_{member2}, \dots, AID_{memberM}> + PAT<AID_{holder} | AID_{newholder}>$

+ Enabler of AID_{holder} + Enabler of $AID_{newholder}$

$\rightarrow PAT<AID_{newholder} | AID_{member1}, AID_{member2}, \dots, AID_{memberM}>$

15 [0227] The method for specifying the validity period value and the transfer control flag value in the PAT containing the Null-AID is similar to the method for specifying the validity period value and the transfer control flag value in the second embodiment described above. Next, the exemplary processings involving the Null-AID will be described.

(1) Case of producing $PAT<AID_{Null} | AID_A>$ from AID_A and Enabler of AID_A :

(a) According to the above described rules (b)(i) and (b)(ii) of the Null-AID, AID_{Null} and Enabler of AID_{Null} are known.

(b) Using MakePAT,

$AID_{Null} + AID_A + Enabler of AID_A + Enabler of AID_{Null}$

$\rightarrow PAT<AID_{Null} | AID_A>$.

(2) Case of producing $PAT<AID_{Null} | AID_A, AID_B>$ from $PAT<AID_{Null} | AID_A>$ and $PAT<AID_{Null} | AID_B>$:

(a) According to the above described rules (b)(i) and (b)(ii) of the Null-AID, AID_{Null} and Enabler of AID_{Null} are known.

(b) Using MergePAT,

$\text{PAT}_{\langle \text{AID}_{\text{Null}} | \text{AID}_A \rangle} + \text{PAT}_{\langle \text{AID}_{\text{Null}} | \text{AID}_B \rangle}$
 >
 + Enabler of AID_{Null}
 → $\text{PAT}_{\langle \text{AID}_{\text{Null}} | \text{AID}_A, \text{AID}_B \rangle}$.

(3) Case of producing $\text{PAT}_{\langle \text{AID}_A | \text{AID}_B \rangle}$ from $\text{PAT}_{\langle \text{AID}_{\text{Null}} | \text{AID}_A \rangle}$, $\text{PAT}_{\langle \text{AID}_{\text{Null}} | \text{AID}_B \rangle}$ and Enabler of AID_A :

- (a) According to the above described rules (b)(i) and (b)(ii) of the Null-AID, AID_{Null} and Enabler of AID_{Null} are known.
- (b) Using TransPAT,

$\text{PAT}_{\langle \text{AID}_{\text{Null}} | \text{AID}_A \rangle} + \text{PAT}_{\langle \text{AID}_{\text{Null}} | \text{AID}_B \rangle}$
 >
 + Enabler of AID_{Null} + Enabler of AID_A
 → $\text{PAT}_{\langle \text{AID}_A | \text{AID}_B \rangle}$.

[0228] As shown in Fig. 25, the data structure of the Null-AID comprises a character string uniquely indicating that it is Null-AID (a character string defined by the CA, for example), which is signed by the CA using the secret key of the CA.

[0229] Also, as shown in Fig. 26, the data structure of the Enabler of Null-AID comprises a character string uniquely indicating that it is Enabler (a character string defined by the CA, for example) and the Null-AID itself, which is signed by the CA using the secret key of the CA.

[0230] Note that the Null-AID and the Enabler of Null-AID are maintained at secure PAT processing devices and secure PAT certification authority.

[0231] Next, the first exemplary application of this third embodiment will be described with reference to Fig. 27, which includes the following operations.

(1) The user-B (PAT member) generates $\text{PAT}_{\langle \text{AID}_{\text{Null}} | \text{AID}_B \rangle}$ by executing the above described exemplary processing (1) involving the Null-AID at the secure PAT processing device which is connected with the terminal of the user-B, and gives it to the user-A (PAT holder) by arbitrary means.

(2) The user-A who received $\text{PAT}_{\langle \text{AID}_{\text{Null}} | \text{AID}_B \rangle}$ carries out the following operations at the secure PAT processing device which is connected with the terminal of the user-A.

- (a) $\text{PAT}_{\langle \text{AID}_{\text{Null}} | \text{AID}_A \rangle}$ is produced by executing the above described exemplary processing (1) involving the Null-AID.
- (b) $\text{PAT}_{\langle \text{AID}_A | \text{AID}_B \rangle}$ is produced by execut-

ing the above described exemplary processing (3) involving the Null-AID.

- (3) The user-A gives the generated $\text{PAT}_{\langle \text{AID}_A | \text{AID}_B \rangle}$ to the user-B by arbitrary means.

[0232] Note that the method for determining the validity period is the same as described above so that it will not be repeated here. Also, the processing involving the Null-AID is the same as described above so that it will not be repeated here.

[0233] In the case of giving $\text{PAT}_{\langle \text{AID}_{\text{Null}} | \text{AID}_A, \text{AID}_B \rangle}$ to the user-B, the above described exemplary processing (2) involving the Null-AID will be executed in the operation (2) described above.

[0234] Next, the second exemplary application of this third embodiment will be described with reference to Fig. 28, which includes the following operations.

- (1) The user-B (PAT member) produces $\text{PAT}_{\langle \text{AID}_{\text{Null}} | \text{AID}_B \rangle}$ by executing the above described exemplary processing (1) involving the Null-AID at the secure PAT processing device which is connected with the terminal of the user-B, and registers it along arbitrary disclosed information at the ADS.
- (2) The user-A produces $\text{PAT}_{\langle \text{AID}_{\text{Null}} | \text{AID}_A \rangle}$ by executing the above described exemplary processing (1) involving the Null-AID at the secure PAT processing device which is connected with the terminal of the user-A, and presents it along arbitrary search conditions to the ADS.
- (3) When the personal information of the user-B satisfies the search conditions presented by the user-A, the secure PAT processing device connected with the ADS carries out the following operations.

- (a) $\text{PAT}_{\langle \text{AID}_{\text{Null}} | \text{AID}_A, \text{AID}_B \rangle}$ is produced by executing the above described exemplary processing (2) involving the Null-AID.
- (b) The produced $\text{PAT}_{\langle \text{AID}_{\text{Null}} | \text{AID}_A, \text{AID}_B \rangle}$ is given to the ADS.

- (4) The ADS gives $\text{PAT}_{\langle \text{AID}_{\text{Null}} | \text{AID}_A, \text{AID}_B \rangle}$ produced by the PAT processing device to the user-A.
- (5) The user-A who received $\text{PAT}_{\langle \text{AID}_{\text{Null}} | \text{AID}_A, \text{AID}_B \rangle}$ produces $\text{PAT}_{\langle \text{AID}_A | \text{AID}_B \rangle}$ by executing the following TransPAT processing at the secure PAT processing device which is connected with the terminal of the user-A.

$\text{PAT}_{\langle \text{AID}_{\text{Null}} | \text{AID}_A \rangle} + \text{PAT}_{\langle \text{AID}_{\text{Null}} | \text{AID}_A, \text{AID}_B \rangle}$
 + Enabler of AID_{Null} + Enabler of AID_A
 → $\text{PAT}_{\langle \text{AID}_A | \text{AID}_B \rangle}$.

[0235] Note that the method for determining the validity period is the same as described above so that it will not be repeated here. Also, the processing involving the Null-AID is the same as described above so that it will not be repeated here.

[0236] In the case of generating PAT<AID_A | AID_B> at the PAT processing device connected with the ADS, Enabler of AID_A will be given to that PAT processing device, and the above described exemplary processing (3) involving the Null-AID will be executed in the operation (3) described above.

[0237] In the case of generating PAT<AID_B | AID_A> at the PAT processing device connected with the ADS and giving it to the user-B, Enabler of AID_B will be given to that PAT processing device, and the above described exemplary processing (3) involving the Null-AID will be executed in the operation (3) described above.

[0238] Next, with references to Fig. 29 to Fig. 31, the fourth embodiment of the email access control scheme according to the present invention will be described in detail.

[0239] In the group communication, a situation where it is desired to fix the participants is frequently encountered, but the above described embodiment does not have a function for making it impossible to change the PAT so that the participants cannot be fixed. Namely, in the above described embodiment, whether or not to fix the participants is left to the judgement of the holder of the PAT.

[0240] For this reason, in this fourth embodiment, a read only attribute is set up in the PAT. More specifically, in this fourth embodiment, the read only attribute is set up in the PAT by using God-AID (AID_{God}).

[0241] Here, the processing involving the God-AID obeys all of the following rules:

- (a) God-AID is known to every user, and
- (b) the processing involving God-AID is allowed only in the following cases:

(i) a case where the AID_{holder} is neither AID_{Null} nor AID_{God}:

PAT<AID_{holder} | AID_{member1}, AID_{member2},
*****, AID_{memberN} > + Enabler of
AID_{holder}

→ PAT<AID_{god} | AID_{holder}, AID_{member1},
AID_{member2}, *****, AID_{memberN} >

(ii) a case where AID_{holder} is AID_{Null}:

PAT<AID_{Null} | AID_{member1}, AID_{member2},
*****, AID_{memberN} >

+ Enabler of AID_{Null}

→ PAT<AID_{god} | AID_{member1}, AID_{member2},

*****, AID_{memberN} >

[0242] As shown in Fig. 29, the data structure of the God-AID comprises a character string uniquely indicating that it is God-AID (a character string defined by the CA, for example), which is signed by the CA using the secret key of the CA. The God-AID is maintained at the secure PAT processing devices and the secure PAT certification authority described above.

[0243] The processings of a PAT that contains the Null-AID are according to Fig. 21 to Fig. 24. When the holder AID is neither Null-AID nor God-AID, the God-AID is appended to the AID list and the holder index value is specified to be a position of the God-AID in the AID list after appending the God-AID. When the holder AID is Null-AID, the Null-AID is deleted from the AID list, the God-AID is appended to the AID list, and then the holder index value is specified to be a position of the God-AID in the AID list after appending the God-AID.

[0244] Next, the exemplary application of this fourth embodiment will be described with reference to Fig. 30.

[0245] In the case of producing PAT<AID_{God} | AID_A, AID_B> from PAT<AID_{Null} | AID_A> and PAT<AID_{Null} | AID_B>, the following processing is executed at the secure PAT processing device which is connected with the terminal of the PAT holder (user-A in Fig. 30).

(1) Using MergePAT,

PAT<AID_{Null} | AID_A> + PAT<AID_{Null} | AID_B>

+ Enabler of AID_{Null}

→ PAT<AID_{Null} | AID_A, AID_B>.

(2) According to the above described rule (a) of the God-AID, AID_{God} is known.

(3) According to the above described rule (b)(ii) of the God-AID,

PAT<AID_{Null} | AID_A, AID_B> + Enabler of AID_{Null}

→ PAT<AID_{god} | AID_A, AID_B>

[0246] The above processing is also executed at the secure PAT processing device connected with a computer (search engine, etc.) of the third person (Fig. 31) or at the secure PAT certification authority.

[0247] Next, with reference to Fig. 32, the fifth embodiment of the email access control scheme according to the present invention will be described in detail.

[0248] When the Null-AID is added as described in the third embodiment, there arises a problem that it becomes possible for the holder of the PAT (the user of the holder AID) to transfer the access right with respect to the member (the user of the member AID) to the third person, and moreover this transfer can be done without a permission of the member, as will be described now.

(1) The holder-A of PAT<AID_A | AID_B> (for the member-B) produces PAT<AID_{Null} | AID_B> by using PAT<AID_A | AID_B>, AID_A and Enabler of AID_A. Here, it is assumed that the holder-A knows all of AID_A, Enabler of AID_A, AID_{Null}, and Enabler of AID_{Null} in addition to PAT<AID_A | AID_B>. 5

(a) The holder-A produces PAT<AID_A | AID_{Null}> using the MakePAT as follows.

$$\text{AID}_A + \text{AID}_{\text{Null}} + \text{Enabler of AID}_{\text{Null}} + \text{Enabler of AID}_A$$

$$\rightarrow \text{PAT} < \text{AID}_A | \text{AID}_{\text{Null}} >$$

(b) The holder-A produces PAT<AID_{Null} | AID_B> using the TransPAT as follows.

$$\text{PAT} < \text{AID}_A | \text{AID}_B > + \text{PAT} < \text{AID}_A | \text{AID}_{\text{Null}} >$$

$$+ \text{Enabler of AID}_A + \text{Enabler of AID}_{\text{Null}}$$

$$\rightarrow \text{PAT} < \text{AID}_{\text{Null}} | \text{AID}_B >$$

25 After the above described operation (1)(b), the holder-A gives PAT<AID_{Null} | AID_B> to the third person-C, the following operation (2) becomes possible.

(2) The third person-C produces PAT<AID_C | AID_B> by using PAT<AID_{Null} | AID_B>. Here, it is assumed that the third person-C knows all of AID_C, Enabler of AID_C, AID_{Null}, and Enabler of AID_{Null} in addition to PAT<AID_{Null} | AID_B>. 30

(a) The third person-C produces PAT<AID_{Null} | AID_C> using the MakePAT as follows.

$$\text{AID}_{\text{Null}} + \text{AID}_C + \text{Enabler of AID}_C + \text{Enabler of AID}_{\text{Null}}$$

$$\rightarrow \text{PAT} < \text{AID}_{\text{Null}} | \text{AID}_C >$$

(b) The third person-C produces PAT<AID_C | AID_B> using the TransPAT as follows.

$$\text{PAT} < \text{AID}_{\text{Null}} | \text{AID}_B > + \text{PAT} < \text{AID}_{\text{Null}} | \text{AID}_C >$$

$$+ \text{Enabler of AID}_{\text{Null}} + \text{Enabler of AID}_C$$

$$\rightarrow \text{PAT} < \text{AID}_C | \text{AID}_B >$$

[0249] As a result of the above described operation (2)(b), the third person-C obtains PAT<AID_C | AID_B> so that accesses to the member-B become possible.

[0250] For this reason, in this fifth embodiment, it is made impossible for the holder of PAT<AID_{holder} | AID-

member> to produce PAT<AID_{Null} | AID_{member}> from this PAT<AID_{holder} | AID_{member}> as long as the holder does not know Enabler of AID_{member}.

[0251] In the third embodiment described above, in order for the PAT holder to produce PAT<AID_{Null} | AID_{member}> without using Enabler of AID_{member}, it is necessary to produce PAT<AID_{holder} | AID_{Null}>.

[0252] To this end, in this fifth embodiment, for the Null-AID described in the third embodiment, the following rule is added:

- the Null-AID can be used only as the holder AID of the PAT (the Null-AID cannot be used as the member AID).

That is, PAT<AID_{Null} | AID_{member1}, AID_{member2}, ..., AID_{memberN}> is allowed, but PAT<AID_{holder} | AID_{Null}, AID_{member1}, AID_{member2}, ..., AID_{memberN}> is not allowed.

Each of the secure PAT processing devices and the secure PAT certification authority is additionally equipped with a function for checking whether the Null-AID is contained as the member AID or not. This member AID checking processing is carried out according to Fig. 32 as follows.

(1) Null-AID and PAT are entered (step S6911).

(2) All the member AIDs are taken out from the PAT entered at the step S6911 (step S6913).

(3) Each of the taken out member AIDs is compared with the Null-AID entered at the step S6911 (step S6915).

If all the member AIDs do not completely match with the Null-AID (step S6917 NO, step S6919 NO), the processing proceeds to the MergePAT, SplitPAT or TransPAT processing (Fig. 21 or Fig. 22) (step S6921).

If there is a member AID that completely matches with the Null-AID (step S6917 YES), the processing is terminated.

[0253] Next, with reference to Fig. 33 to Fig. 39, the sixth embodiment of the email access control scheme according to the present invention will be described in detail.

[0254] This sixth embodiment differs from the first embodiment described above in that a link information is added to the AID of Fig. 2 used in the first embodiment, as shown in a part (b) of Fig. 34, while a link information of the AID is set instead of the AID itself that is contained in the 1-to-1 PAT of Fig. 2, as shown in a part (c) of Fig. 34, such that the AID is uniquely identified by the link information.

[0255] Note that such an AID to which the link information is added will be referred to as a link information attached AID, and a 1-to-1 PAT having the link information of the AID will be referred to as a link specifying 1-to-1 PAT. Also, the link information is an information

capable of uniquely identifying the AID, which is given by a kind of data generally known as identifier such as a serial number uniquely assigned to the AID by the CA for example.

[0256] Fig. 33 shows an overall configuration of a communication system in this sixth embodiment.

[0257] In Fig. 33, the CA (Certification Authority) 1 has a right to authenticate OIDs and a right to issue AIDs, and functions to allocate AIDs to users 3.

[0258] The SCS (Secure Communication Service) 5 transfers emails among the users 3, carries out the receiving refusal and the identity judgement and the extraction of the OID according to the need.

[0259] The ADS (Anonymous Directory Service) 7 is a database for managing the AID, the transfer control flag value, the validity period value, and the disclosed information of each user 3. The ADS 7 has a function to generate the PAT from the AID of a searcher and the AID of a registrant who satisfies the search conditions, and issue it to the searcher.

[0260] A series of processing from generating the AID from the OID according to a request from a user until allocating the AID to that user is basically the same as in the first embodiment, except that the link information is to be added, which will now be described with reference to Fig. 34.

[0261] Fig. 34 shows exemplary formats of the OID, the link information attached AID, and the link specifying 1-to-1 PAT. As shown in a part (a) of Fig. 34, the OID is an information comprising an arbitrary character string according to a rule by which the CA 1 can uniquely identify the user and a public key, which is signed by the CA 1.

[0262] Also, as shown in a part (b) of Fig. 34, the link information attached AID is an information comprising fragments of the OID and their position information, redundant character strings, an SCS information given by an arbitrary character string (host name, real domain name, etc.) by which a host or a domain that is operating the SCS 5 can be uniquely identified on the network, and the link information, which is signed by the CA 1.

[0263] Also, as shown in a part (c) of Fig. 34, the link specifying 1-to-1 PAT is an information comprising the transfer control flag, the link information of AID₀, the link information of AID₁, and the validity period, which is signed by the ADS 7 using a secret key of the ADS 7.

[0264] A procedure by which the user 3 requests the link information attached AID to the CA 1 is the same as that of the first embodiment. A procedure by which the CA 1 issues the link information attached AID to the user 3 in response to a request for the AID is also the same as that of the first embodiment.

[0265] Next, the link information attached AID generation processing at the CA will be described with reference to Fig. 35.

[0266] In the procedure of Fig. 35, the CA 1 generates an information of a length equal to the total length L of the OID, and sets this information as a tentative AID

(step S7211). Then, in order to carry out the partial copying of the OID, values of parameters p_i and l_i for specifying a copying region are determined using arbitrary means such as random number generation respectively (step S7213). Here, L is equal to the total length L of the OID, and l_i is an arbitrarily defined value within a range in which a relationship of 0 ≤ l_i ≤ L holds. Then, an information in a range between a position p_i to a position p_i + l_i from the top of the OID is copied to the same positions in the tentative AID (step S7215). In other words, this OID fragment will be copies to a range between a position p_i and a position p_i + l_i from the top of the tentative AID. Then, the values of p_i and l_i are written into a prescribed range in the tentative AID into which the OID has been partially copied, in a form encrypted by an arbitrary means (step S7217). Then, an SCS information given by an arbitrary character string (host name, real domain, etc.) that can uniquely identify a host or a domain that is operating the SCS 5 on the network is written into a prescribed range in the tentative AID into which these values are written (step S7219). Then, the link information is written (step S7220). Then, the tentative AID into which the above character string and the link information are written is signed using a secret key of the CA 1 (step S7221).

[0267] Next, a procedure for registering the AID of a user-B 3 and the disclosed information into the ADS 7 will be described. First, the bidirectional authentication by arbitrary means using the AID of the user-B 3 and the certificate of the ADS 7 is carried out between the user-B 3 who is a registrant and the ADS 7. Then, the user-B 3 transmits the transfer control flag value, the validity period value, and the disclosed information such as interests to the ADS 7. Then, the ADS 7 stores the transfer control flag value, the validity period value, and the entire disclosed information in relation to the AID of the user-B 3 in its storage device. Here, there can be cases where communications between the user-B 3 who is the registrant and the ADS 7 are to be encrypted.

[0268] Next, a procedure by which a user-A 3 searches through the disclosed information that is registered in the ADS 7 will be described. First, the bidirectional authentication by arbitrary means using the AID of the user-A 3 and the certificate of the ADS 7 is carried out between the user-A 3 who is a searcher and the ADS 7. Then, the user-A 3 transmits arbitrary search conditions to the ADS 7. Then, the ADS 7 presents all the received search conditions to its storage device, and extracts the AID of a registrant which satisfies these search conditions. Then, the ADS 7 generates the link specifying 1-to-1 PAT from the link information of the AID of the user-A 3 and the link information of the AID of the registrant who satisfied the search conditions, the transfer control flag value, and the validity period value. Then, the ADS 7 transmits the generated PAT to the user-A 3. Here, there can be cases where communications between the user-A 3 who is a searcher and the ADS 7 are to be encrypted. Note that the link specifying

1-to-1 PAT is generated as a search result of the ADS 7. [0269] Next, the link specifying 1-to-1 PAT generation processing at the ADS 7 will be described with reference to Fig. 36.

[0270] First, an information of a prescribed length is generated, and this information is set as a tentative PAT (step S7510). Then, the link information of the AID of the user-A 3 who is a searcher and the link information of the AID of the user-B 3 who is a registrant are copied into a prescribed region of the tentative PAT (step S7516). Then, the transfer control flag value and the validity period value are written into respective prescribed regions of the tentative PAT into which the link informations of the AIDs are copied (step S7517). Then, the tentative PAT into which these values are written is signed using a secret key of the ADS 7 (step S7519).

[0271] Next, the transfer control using the link specifying 1-to-1 PAT will be described. The transfer control is a function for limiting accesses to a user who has a proper access right from a third person to whom the PAT has been transferred or who has eavesdropped the PAT (a user who originally does not have the access right).

[0272] The ADS 7 and the user-B 3 of the registrant AID can prohibit a connection to the user-B 3 from a third person who does not have the access right, by setting a certain value in to the transfer control flag of the PAT.

[0273] When the transfer control flag value is set to be 1, the sender's AID is authenticated between the SCS 5 and the sender according to an arbitrary challenge/response process, so that even if the sender gives both the sender's AID and the PAT to another user other than the sender, that another user will not be able to make a connection to the registrant of the ADS 7 through the SCS 5.

[0274] On the other hand, when the transfer control flag value is set to be 0, no challenge/response process will be carried out between the SCS 5 and the sender, so that if the sender gives both the sender's AID and the PAT to another user other than the sender, that another user will also be able to make a connection to the registrant of the ADS 7 through the SCS 5.

[0275] Next, the email access control method at the SCS 5 will be described with reference to Fig. 37.

[0276] The sender specifies "[sender's AID]@[real domain of SCS of sender]" in From: line, and "[PAT]@[real domain of SCS of sender]" in To: line.

[0277] The SCS 5 acquires a mail received by an MTA (Message Transfer Agent) such as SMTP (Simple Mail Transfer Protocol), and executes the processing of Fig. 37 as follows.

(1) The signature of the PAT is verified using a public key of the ADS 7 (step S7713).

When the PAT is found to have been altered (step S7715 YES), the mail is discarded and the processing is terminated (step S7716).

When the PAT is found to have been not altered

5

10

15

20

25

30

35

40

45

50

55

(step S7715 NO), the following processing (2) is executed.

(2) The search is carried out by presenting the link information of the sender's AID to the PAT (steps S7717, S7720, S7722).

When a link information that completely matches with the link information of the sender's AID is not contained in the PAT (step S7723 NO), the mail is discarded and the processing is terminated (step S7716).

When a link information that completely matches with the link information of the sender's AID is contained in the PAT (step S7723 YES), the following processing (3) is executed.

(3) The validity period value of the PAT is evaluated (steps S7725, S7727).

When the PAT is outside the validity period (step S7727 NO), the mail is discarded and the processing is terminated (step S7716).

When the PAT is within the validity period (step S7727 YES), the following processing (4) is executed.

(4) Whether or not to authenticate the sender is determined by referring to the transfer control flag value of the PAT (steps S7731, S7733).

When the value is 1 (step S7733 YES), the SCS 5 acquires the sender's AID itself and the public key of the sender's AID by presenting the link information to the CA 1, and then the challenge/response authentication between the SCS 5 and the sender is carried out, and the signature of the sender is verified (step S7735). When the signature is valid, the recipient is specified and the PAT is attached (step S7737). When the signature is invalid, the mail is discarded and the processing is terminated (step S7716).

When the value is 0 (step S7733 NO), the recipient is specified and the PAT is attached without executing the challenge/response authentication (step S7737).

[0278] The challenge/response authentication between the SCS 5 and the sender is the same as that for the 1-to-1 PAT described above.

[0279] Next, a method for specifying the recipient at the SCS 5 will be described. First, the SCS 5 carries out the search by presenting the link information of the sender's AID to the PAT, so as to acquire all the link informations which do not completely match the link information of the sender's AID. Then, the search is carried out by presenting all these acquired link informations to the CA 1 so as to acquire the AIDs. All these acquired AIDs will be defined as recipient's AIDs hereafter. Then, for every recipient's AID, the real domain of SCS of recipient is taken out from the recipient's AID. Then, the recipient is specified in a format of "[recipient's AID]@[real domain of SCS of recipient]". Finally, the SCS 5 changes the sender from a format of

"[sender's AID]@[real domain of SCS of sender]" to a format of "sender's AID".

[0280] The method for attaching the PAT at the SCS 5 is the same as that for the 1-to-1 PAT described above.

[0281] Next, a method of receiving refusal with respect to the PAT at the SCS 5 will be described.

[0282] Receiving refusal setting: The bidirectional authentication is carried out by an arbitrary means between the user and the SCS 5. Then, the user transmits a registration command, his/her own AID, and arbitrary PATs to the SCS 5. Then, the SCS 5 verifies the signature of the received AID. If the signature is invalid, the processing of the SCS 5 is terminated. If the signature is valid, the SCS 5 next verifies the signature of each received PAT using a public key of the ADS. Those PATs with the invalid signature are discarded by the SCS 5. When the signature is valid, the SCS 5 takes out the link information from the received AID, and then carries out the search by presenting the taken out link information to each PAT. For each of those PATs which contain the link information that completely matches with the link information of the received AID, the SCS 5 presents the registration command and the PAT to the storage device such that the PAT is registered into the storage device. Those PATs which do not contain the link information that completely matches with the link information of the received AID are discarded by the SCS 5 without storing them into the storage device. Here, there can be cases where communications between the user and the SCS 5 are to be encrypted.

[0283] Receiving refusal execution: The SCS 5 carries out the search by presenting the PAT to the storage device. When a PAT that completely matches the presented PAT is registered in the storage device, the mail is discarded. When a PAT that completely matches the present PAT is not registered in the storage device, the mail is not discarded.

[0284] Receiving refusal cancellation: The bidirectional authentication is carried out by an arbitrary means between the user and the SCS 5. Then, the user presents his/her own AID to the SCS 5. Then, the SCS 5 verifies the signature of the received AID. If the signature is invalid, the processing of the SCS 5 is terminated. If the signature is valid, the SCS 5 next takes out the link information from the presented AID, and presents the taken out link information as a search condition to the storage device and acquire all the PATs that contain the presented link information, and then presents all the acquired PATs to the user. Then, the user selects all the PATs for which the receiving refusal is to be cancelled by referring to all the PATs presented from the SCS 5, and transmits all the selected PATs along with a deletion command to the SCS 5. Upon receiving the deletion command and all the PATs for which the receiving refusal is to be cancelled, the SCS 5 presents the deletion command and all the PATs received from the user to the storage device, such that all the received PATs are deleted from the storage

device.

[0285] Note that the method of receiving refusal with respect to the link specifying 1-to-N PAT at the SCS 5 is the same as the method of receiving refusal with respect to the link specifying 1-to-1 PAT described above.

[0286] Next, the judgement of identity will be described with reference to Fig. 38 and Fig. 39.

- 10 (1) An initial value of a variable OID_M is defined as a bit sequence with a length equal to the total length L of the OID and all values equal to "0". Also, an initial value of a variable OID_V is defined as a bit sequence with a length equal to the total length of the OID and all values equal to "0" (step S7911).
- 15 (2) One link information attached AID is selected from a set of processing target link information attached AIDs, and the following bit processing is carried out (step S7913).
 - 20 (a) Values of variables AID_M and AID_V are determined according to the position information contained in the link information attached AID (step S7915). Here, AID_M is defined as a bit sequence with a length equal to the total length L of the OID and a value of a position at which the OID information is defined is "1" while a value of a position at which the OID information is not defined is "0" (see Fig. 39). Also, AID_V is defined as a bit sequence with a length equal to the total length L of the OID and a value of a position at which the OID information is defined is an actual value of the OID information while a value of a position at which the OID information is not defined is 0 (see Fig. 39).
 - 25 (b) AND processing of OID_M and AID_M is carried out and its result is substituted into a variable OVR_M (step S7917).
 - 30 (c) AND processing of OVR_M and AID_M as well as AND processing of OVR_M and OID_M are carried out and their results are compared (step S7919). When they coincide, OR processing of OID_M and AID_M is carried out and its result is substituted into OID_M (step S7921), while OR processing of OID_V and AID_V is also carried out and its result is substituted into OID_M (step S7923). On the other hand, when they do not coincide, the processing proceeds to the step S7925.
 - 35 (d) A link information attached AID to be processed next is selected from a set of processing target link information attached AIDs. When at least one another link information attached AID is contained in the set, the steps S7913 to S7923 are executed for that another link information attached AID. When no other link information attached AID is contained in the set, the

processing proceeds to the step S7927.

(e) Values of OID_M and OID_Y are outputted (step S7927).

[0287] The value of OID_M that is eventually obtained indicates all positions of the OID information that can be recovered from the set of processing target link information attached AIDs. Also, the value of OID_Y that is eventually obtained indicates all the OID information that can be recovered from the set of processing target link information attached AID. In other words, by using the values of OID_M and OID_Y , it is possible to obtain the OID albeit probabilistically when the value of OID_Y is used as a search condition, and it is possible to quantitatively evaluate a precision of the above search by a ratio OID_M/L with respect to the total length L of the OID.

[0288] As described above, in this sixth embodiment, the CA 1 which is a Trusted Third Party with high secrecy and credibility generates the link information attached AID in which the personal information is concealed, from the OID that contains the highly secret personal information such as name, telephone number, real email address, etc., according to a user request, and issues the AID to the user. By identifying the user by this AID on the communication network as well as in various services provided on the communication network, it becomes possible to provide both the anonymity guarantee and the identity guarantee for the user. In other words, it becomes possible for the user to communicate with another user without revealing the own real name, telephone number, email address, etc., to that another user, and it also becomes possible to disclose the disclosed information to unspecified many through the ADS 7 as will be described below.

[0289] The user registers the disclosed information, that is an information which is supposed to have a low secrecy compared with the personal information at the ADS 7. In the case of searching the disclosed information and the registrant AID, the searcher presents the link information attached AID of the searcher and arbitrary search conditions to the ADS 7. The ADS 7 then extracts the registrant link information attached AID that satisfies these search conditions, and generates the link specifying 1-to-1 PAT from the link information of the AID of the searcher and the link information of the AID of the registrant who satisfied the search conditions, the transfer control flag value, and the validity period value.

[0290] In this link specifying 1-to-1 PAT, the transfer control flag value and the validity period value are set as shown a part (c) of Fig. 34, and by setting up this validity period in advance, it is possible to limit connections from the sender.

[0291] It is also possible to prohibit connections from a third person who does not have the access right, by using the transfer control flag value. Namely, when the transfer control flag value is set to be 1, the sender's AID is authenticated between the SCS 5 and the sender according to an arbitrary challenge/response process,

so that even if the sender gives both the sender's AID and the PAT to another user other than the sender, that another user will not be able to make a connection to the registrant of the ADS 7 through the SCS 5. On the other hand, when the transfer control flag value is set to be 0, no challenge/response process will be carried out between the SCS 5 and the sender, so that if the sender gives both the sender's AID and the PAT to another user other than the sender, that another user will also be able to make a connection to the registrant of the ADS 7 through the SCS 5.

[0292] It is also possible to make a connection request to the communication network such that a call for which the recipient is specified by the link specifying 1-to-1 PAT will be received by the recipient's AID or the sender's AID specified by the link information of the link specifying 1-to-1 PAT. In addition, it is also possible to refuse receiving calls with the link specifying 1-to-1 PAT selected by the recipient among calls which are specified by the link specifying 1-to-1 PAT. It is also possible to cancel the receiving refusal of the calls with the link specifying 1-to-1 PAT selected by the recipient. In addition, as a measure against the sender who repeats the personal attack using a plurality of sender's AIDs by taking an advantage of the anonymity, it is possible to judge the identity of the OID from these plurality of sender's AIDs and it is possible to extract that OID at some probability.

[0293] Next, with references to Fig. 40 to Fig. 49, the seventh embodiment of the email access control scheme according to the present invention will be described in detail.

[0294] In contrast to the sixth embodiment described above which is directed to the case where a sender and a recipient are set in 1-to-1 correspondence, this seventh embodiment is directed to the case where a sender and recipients are set in 1-to-N correspondence and a generation of a new link specifying 1-to-N PAT and a content change of the existing link specifying 1-to-N PAT can be made by the initiative of a user, similarly as in the second embodiment described above. Here, the sender is either a holder of the PAT or a member of the PAT. Similarly, the recipient is either a holder of the PAT or a member of the PAT.

[0295] As described in the second embodiment, in general, a membership of a group communication (mailing list, etc.) is changing dynamically so that it is necessary for a host of the group communication to manage information on a point of contact such as telephone number, email address, etc., of each member. In contrast, in the case where it is possible to newly generate a 1-to-1 PAT as in the sixth embodiment, the management of a point of contact is difficult. For example, it is difficult to manage the group collectively, and even if it is given to the others for the purpose of the transfer control, it does not function as an address of the group communication such as mailing list.

[0296] In this seventh embodiment, in order to resolve

such a problem, it is made possible to carry out a generation of a new link specifying 1-to-N PAT and a content change or the existing link specifying 1-to-N PAT by the initiative of a user.

[0297] First, the definition of various identifications used in this seventh embodiment will be described with references to Fig. 40 and Fig. 41.

[0298] As shown in a part (a) of Fig. 40, the OID is an information comprising an arbitrary character string (telephone number, email address, etc.) according to a rule by which the CA 1 can uniquely identify the user and a public key, which is signed by the CA 1.

[0299] Also, as shown in a part (b) of Fig. 40, the link information attached AID is an information comprising fragments of the OID and their position information, redundant character strings, an SCS information given by an arbitrary character string (host name, real domain name, etc.) by which a host or a domain that is operating the SCS 5 can be uniquely identified on the network, and a link information, which is signed by the CA 1. Note that the AID may be encrypted at the SCS 5 or the CA 1. The link information is the same as in the sixth embodiment.

[0300] Also, as shown in a part (c) of Fig. 40, the link specifying 1-to-N PAT is an information comprising two or more link informations of AIDs, a holder index, the validity period, the transfer control flag, and a PAT processing device identifier, which is signed using a secret key of the PAT processing device.

[0301] Here, one of the link informations of AIDs is the link information of the holder AID of this PAT, where the change of the information contained in the PAT such as an addition of the link information of AID to the PAT, a deletion of the link information of AID from the PAT, a change of the validity period in the PAT, a change of the transfer control flag value in the PAT, etc., can be made by presenting the link information of the holder AID and a corresponding Enabler to the PAT processing device.

[0302] On the other hand, the link informations of AIDs other than the link information of the holder AID that are contained in the PAT are all link information of member AIDs, where a change of the information contained in the PAT cannot be made even when the link information of the member AID and a corresponding Enabler are presented to the PAT processing device.

[0303] The holder index is a numerical data for identifying the link information of the holder AID, which is defined to take a value 1 when the link information of the holder AID is a top link information of AID in the link specifying AID list formed from the link information of the holder AID and the link informations of the member AIDs, a value 2 when the link information of the holder AID is a second link information of AID from the top of the link specifying AID list, or a value n when the link information of the holder AID is an n-th link information of AID from the top of the link specifying AID list.

[0304] The transfer control flag value is defined to take either 0 or 1 similarly as in the case of the link specifying

1-to-1 PAT.

[0305] The link information of the holder AID is defined to be a link information of AID which is written at a position of the holder index value in the link specifying AID list. The link informations of the member AIDs are defined to be all the link informations of AIDs other than the link information of the holder AID.

[0306] The validity period is defined by any one or combination of the number of times for which the PAT is available, the absolute time (UTC) by which the PAT becomes unavailable, the absolute time (UTC) by which the PAT becomes available, and the relative time (lifetime) since the PAT becomes available until it becomes unavailable.

[0307] The identifier of a PAT processing device (or a PAT processing object on the network) is defined as a serial number of the PAT processing device (or an distinguished name of the PAT processing object on the network). The secret key of the PAT processing device (or the PAT processing object on the network) is defined to be uniquely corresponding to the identifier.

[0308] Also, in this second embodiment, an Enabler is introduced as an identifier corresponding to the AID. As shown in Fig. 41, the Enabler is an information comprising a character string uniquely indicating that it is an Enabler and a link information attached AID itself, which is signed by the CA 1.

[0309] Next, the operations for a generation of a new PAT and a content change of the existing PAT will be described. Here, the following operations are defined at a secure PAT processing device on the communication terminal or a PAT processing object on the CA or on a network which is properly requested from the CA (which will also be referred to as a PAT processing device hereafter). These operations are similar to those of the second embodiment described above so that they will be described by referring to Fig. 10 to Fig. 13 but it is assumed that each occurrence of AID in Fig. 10 to Fig. 13 should be replaced by the link information of AID in the following.

1. Editing of link specifying AID list:

A link specifying AID list, which is a list of link informations of AIDs contained in the PAT, is edited using link information attached AIDs and Enabler. Else, the link specifying AID list is newly generated.

2. Setting of the validity period and the transfer control flag:

The validity period value and the transfer control flag value contained in the PAT are changed using a link information attached AID and Enabler. Also, a new validity period value and a new transfer control flag value are set in the newly generated link specifying AID list.

[0310] A user who presented the holder AID and the Enabler corresponding to this holder AID to the PAT processing device can edit the list of link informations of

AIDs contained in the PAT. In this case, the following processing rules are used.

(1) Generating a new PAT (MakePAT) (see Fig. 10):

The link specifying AID list (LALIST<(link)holder AID | (link)member AID₁, (link)member AID₂, ..., (link)member AID_n>) where (link)AID_x denotes the link information of AID_x is newly generated, and the validity period value and the transfer control flag value are set with respect to the generated LALIST. 5

(link)AID_A + (link)AID_B + Enabler of AID_B

+ Enabler of AID_A 15

→ LALIST<(link)AID_A | (link)AID_B>

LALIST<(link)AID_A | (link)AID_B> + Enabler of AID_A 20

+ validity period value

+ transfer control flag value

→ PAT<(link)AID_A | (link)AID_B> 25

(2) Merging PATs (MergePAT) (see Fig. 11):

A plurality of LALISTS of the same holder AID are merged and the validity period value and the transfer control flag value are set with respect to the merged LALIST. 30

LALIST<(link)AID_A | (link)AID_{B1}, (link)AID_{B2}, ...> 35

+ LALIST<(link)AID_A | (link)AID_{C1}, (link)AID_{C2}, ...>

+ Enabler of AID_A 40

→ LALIST<(link)AID_A | (link)AID_{B1}, (link)AID_{B2}, ..., (link)AID_{C1}, (link)AID_{C2}, ...>

LALIST<(link)AID_A | (link)AID_{B1}, (link)AID_{B2}, ..., (link)AID_{C1}, (link)AID_{C2}, ...> 45

+ Enabler of AID_A + validity period value 50

+ transfer control flag value

→ PAT<(link)AID_A | (link)AID_{B1}, (link)AID_{B2}, ..., (link)AID_{C1}, (link)AID_{C2}, ...> 55

(3) Splitting a PAT (SplitPAT) (see Fig. 12):

The LALIST is split into a plurality of LALISTS of the same holder AID, and the respective validity period value and transfer control flag value are set with respect to each one of the split LALISTS.

LALIST<(link)AID_A | (link)AID_{B1}, (link)AID_{B2}, ..., (link)AID_{C1}, (link)AID_{C2}, ...>

+ Enabler of AID_A

→ LALIST<(link)AID_A | (link)AID_{B1}, (link)AID_{B2}, ...>

+ LALIST<(link)AID_A | (link)AID_{C1}, (link)AID_{C2}, ...>

LALIST<(link)AID_A | (link)AID_{C1}, (link)AID_{C2}, ...>

+ Enabler of AID_A + validity period value

+ transfer control flag value

→ PAT<(link)AID_A | (link)AID_{C1}, (link)AID_{C2}, ...>

(4) Changing a holder of a PAT (TransPAT) (see Fig. 13):

The holder AID of the LALIST is changed, and the validity period value and the transfer control flag value are set with respect to the changed LALIST.

LALIST<(link)AID_A | (link)AID_B>

+ LALIST<(link)AID_B | (link)AID_{C1}, (link)AID_{C2}, ...>

+ Enabler of AID_A + Enabler of AID_B

→ LALIST<(link)AID_B | (link)AID_{C1}, (link)AID_{C2}, ...>

LALIST<(link)AID_B | (link)AID_{C1}, (link)AID_{C2}, ...>

+ Enabler of AID_B + validity period value

+ transfer control flag value

→ PAT<(link)AID_B | (link)AID_{C1}, (link)AID_{C2}, ...>

[0311] In the operation for setting the validity period value, in order to permit the setting of the validity period value only to a user who holds both the holder AID and the corresponding Enabler, the following operation is defined.

PAT<(link)AID_A | (link)AID_B> + Enabler of AID_A

+ validity period value

→ PAT<(link)AID_A | (link)AID_B>

5

[0312] In the operation for setting the transfer control flag value, in order to permit the setting of the transfer control flag value only to a user who holds both the holder AID and the corresponding Enabler, the following operation is defined.

PAT<(link)AID_A | (link)AID_B> + Enabler of AID_A

+ transfer control flag value

15

→ PAT<(link)AID_A | (link)AID_B>

[0313] Next, with references to Fig. 42 to Fig. 48, the overall system configuration of this seventh embodiment will be described. In Fig. 42 to Fig. 48, the user-A who has AID_A allocated from the CA stores AID_A and Enabler of AID_A in a computer of the user-A, and the input/output devices such as floppy disk drive, CD-ROM drive, communication board, microphone, speaker, etc., are connected. Else, AID_A and Enabler of AID_A are stored in a communication terminal (telephone, cellular phone, etc.) which has a storage device and a data input/output function.

20

[0314] Similarly, the user-B who has AID_B allocated from the CA stores AID_B and Enabler of AID_B in a computer of the user-B, and the input/output devices such as floppy disk drive, CD-ROM drive, communication board, microphone, speaker, etc., are connected. Else, AID_B and Enabler of AID_B are stored in a communication terminal (telephone, cellular phone, etc.) which has a storage device and a data input/output function.

25

[0315] In the following, a procedure by which the user-A generates PAT<(link)AID_A | (link)AID_B> will be described.

40

(1) The user-A acquires AID_B and Enabler of AID_B using any of the following means.

- AID_B and Enabler of AID_B are registered at the ADS 7, and it is waited until the user-A acquires them as a search result (Fig. 42).
- AID_B and Enabler of AID_B are directly transmitted to the user-A by the email, signaling, etc. (Figs. 43, 44).
- AID_B and Enabler of AID_B are stored in a magnetic, optic, or electronic medium such as floppy disk, CD-ROM, MO, IC card, etc., and this medium is given to the user-A. Else, it is waited until the user acquires them by reading this medium (Figs. 45, 46).
- AID_B and Enabler of AID_B are printed on a paper medium such as book, name card, etc.,

45

50

[0316] The merging of PATs (MergePAT, Fig. 21, Fig. 49), the splitting of a PAT (SplitPAT, Fig. 22, Fig. 49), and the changing of a holder of a PAT (TransPAT, Fig. 21, Fig. 49) are also carried out by the similar procedure.

and this medium is given to the user-A. Else, it is waited until the user-A acquire them by reading this medium (Figs. 47, 48).

(2) The user-A who has acquired AID_B and Enabler of AID_B by any of the means described in the above (1) issues the MakePAT command to the PAT processing device. This procedure is common to Fig. 42 to Fig. 48, and defined as follows.

(a) The user A requests the issuance of the MakePAT command by setting AID_A, Enabler of AID_A, AID_B, Enabler of AID_B, the validity period value, and the transfer control flag value into the communication terminal of the user-A.

(b) The communication terminal of the user-A generates the MakePAT command.

(c) The communication terminal of the user-A transmits the generated MakePAT command to the PAT processing device by means such as the email, signaling, etc. (the issuance of the MakePAT command).

(d) The PAT processing device generates PAT<(link)AID_A | (link)AID_B> by processing the received MakePAT command according to Fig. 21 and Fig. 49. More specifically, this is done as follows.

(link)AID_A + (link)AID_B

+ Enabler of AID_B + Enabler of AID_A

→ LALIST<(link)AID_A | (link)AID_B>

LALIST<(link)AID_A | (link)AID_B> + Enabler of AID_A

+ validity period value + transfer control flag value

→ PAT<(link)AID_A | (link)AID_B>

(e) The PAT processing device transmits the generated PAT<(link)AID_A | (link)AID_B> to the communication terminal of the user-A, or to the communication terminal of the user-B according to the need, by means such as the email, signaling, etc.

(f) The communication terminal of the user-A (or the user-B) stores the received PAT<(link)AID_A | (link)AID_B> in the storage device of the communication terminal of the user-A.

[0317] The procedure of MakePAT, MergePAT and TransPAT is similar to that described above with reference to Fig. 21, except that the AID should be replaced by the link information of the AID and the AID list should be replaced by the link specifying AID list. Also, the procedure of SplitPAT is similar to that described above with reference to Fig. 22, except that the AID should be replaced by the link information of the AID and the AID list should be replaced by the link specifying AID list.

[0318] Here, in the procedures of Fig. 21 and Fig. 22, the link specifying AID list generation is carried out according to Fig. 49 as follows. Namely, a buffer length is determined first (step S9011) and a buffer is generated (step S9012). Then, the link information of the holder AID is copied to a vacant region of the generated buffer (step S9017). Then, the link information of the member AID is copied to a vacant region of the resulting buffer (step S9018), and if the next member AID exists (step S9015 YES), the step S9018 is repeated.

[0319] Next, the determination of the link information of the holder AID will be described. Each of the MakePAT, the MergePAT, the SplitPAT, and the TransPAT commands is defined to have two or more arguments, where AID, PAT, or Enabler can be specified as an argument. In this case, the PAT processing device specifies the link information of the holder AID of the PAT to be outputted after executing each command according to the following rules.

* Case of the MakePAT:

For the MakePAT command, it is defined that AIDs are to be specified for the first argument to the N-th argument ($N = 2, 3, \dots$) and Enablers are to be specified for the N+1-th and subsequent arguments. For example, they can be specified as follows.

MakePAT AID₁, AID₂, ..., AID_N,
Enabler of AID₁, Enabler of AID₂,
..., Enabler of AID_N

The PAT processing device interprets the link information of AID of the first argument of the MakePAT command as the link information the holder AID.

Only when one of the Enablers of the N+1-th and subsequent arguments corresponds to the AID of the first argument, the PAT processing device specifies the link information of this AID (that is the link information of the AID of the first argument) as the link information of the holder AID of the PAT to be outputted after executing the MakePAT command.

* Case of the MergePAT:

For the MergePAT command, it is defined that PATs are to be specified for the first argument to the N-th argument ($N = 2, 3, \dots$) and Enabler is to be specified for the N+1-th argument.

Namely, they can be specified as follows.

MergePAT PAT₁, PAT₂, ..., PAT_N Enabler of AID

The PAT processing device interprets the link information of the holder AID of the PAT of the first argument of the MergePAT command as the link information of the holder AID of the PAT to be outputted after executing the MergePAT command.

Only when the Enabler of the N+1-th argument corresponds to the holder AID of the PAT of the first argument, the PAT processing device specifies the link information of this AID (that is the link information of the holder AID of the PAT of the first argument) as the link information of the holder AID of the PAT to be outputted after executing the MergePAT command.

Case of the SplitPAT:

For the SplitPAT command, it is defined that PAT is to be specified for the first argument, a set of one or more AIDs grouped together by some prescribed symbols (assumed to be parentheses () in this example) are to be specified for the second argument to the N-th argument ($N = 3, 4, \dots$), and Enabler is to be specified for the N+1-th argument. Namely, they can be specified as follows.

SplitPAT PAT₁ (AID₁₁) (AID₂₁ AID₂₂)
..., (AID_{N1} AID_{N2} ...) Enabler of AID

The PAT processing device interprets the link information of the holder AID of the PAT of the first argument of the SplitPAT command as the link information of the holder AID of the PAT to be outputted after executing the SplitPAT command.

Only when the Enabler of the N+1-th argument corresponds to the holder AID of the PAT of the first argument, the PAT processing device specifies the link information of this AID (that is the link information of the holder AID of the PAT of the first argument) as the link information of the holder AID of the PAT to be outputted after executing the SplitPAT command.

Case of the TransPAT:

For the TransPAT command, it is defined that PATs are to be specified for the first argument and the second argument, an AID is to be specified for the third argument, and Enablers are to be specified for the fourth argument and the fifth argument. Namely, they can be specified as follows.

TransPAT PAT₁, PAT₂ AID Enabler of AID₁, Enabler of AID₂

The PAT processing device interprets the link

information of AID of the third argument as the link information of the holder AID of the PAT to be outputted after executing the TransPAT command provided that the link information of AID of the third argument of the TransPAT command is contained in the PAT of the second argument.

Only when the Enabler of the fourth argument corresponds to both the PAT of the first argument and the PAT of the second argument and the Enabler of the fifth argument corresponds to the AID of the third argument, the PAT processing device specifies the link information of the AID of the third argument as the link information of the holder AID of the PAT to be outputted after executing the TransPAT command.

Next, the determination of the link informations of the member AIDs will be described. The definitions of the MakePAT, the MergePAT, the SplitPAT, and the TransPAT commands are as described above. The PAT processing device specifies the link informations of the member AIDs of the PAT to be outputted after executing each command according to the following rules.

Case of the MakePAT:

Only when the link information of the holder AID of the PAT to be outputted after executing the MakePAT command is formally determined, the PAT processing device interprets all the link informations of the AIDs of the second and subsequent arguments of the MakePAT command as the link informations of the member AIDs of the PAT to be outputted after executing the MakePAT command.

The PAT processing device specifies only the link informations of those AIDs among all the AIDs of the second and subsequent arguments which correspond to the Enablers specified by the N+1-th and subsequent arguments as the link informations of the member AIDs of the PAT to be outputted after executing the MakePAT command.

Case of the MergePAT:

Only when the link information of the holder AID of the PAT to be outputted after executing the MergePAT command is formally determined, the PAT processing device specifies the link informations of the member AIDs of all the PATs specified by the first to N-th arguments of the MergePAT as the link informations of the member AIDs of the PAT to be outputted after executing the MergePAT command.

Case of the SplitPAT:

Only when the link information of the holder AID of the PAT to be outputted after executing the SplitPAT command is formally determined, the PAT processing device specifies the link information of the member AID of the PAT specified by the first argument of the SplitPAT command as the link information of the member AID of the PAT to be outputted after executing the SplitPAT command. At this

point, the link informations of the member AIDs are distributed into different PATs in units of parentheses (). For example, in the case of:

SplitPAT PAT (AID₁₁) (AID₂₁ AID₂₂)
..... (AID_{N1} AID_{N2})
AID_{NM}) Enabler of AID

the link informations of (AID₁₁), (AID₂₁ AID₂₂) and (AID_{N1} AID_{N2} AID_{NM}) will be the link informations of the member AIDs of different PATs having a common link information of holder AID.

* Case of TransPAT:

Only when the link information of the holder AID of the PAT to be outputted after executing the TransPAT command is formally determined, the PAT processing device specifies all the link informations of the member AIDs remaining after excluding the link information of the member AID that is scheduled to be a new holder AID from all the link informations of the member AIDs of the PAT specified by the first argument of the TransPAT command and the link informations of the member AIDs of the PAT specified by the second argument as the link informations of the member AIDs of the PAT to be outputted after executing the TransPAT command.

The verification of the properness of the Enabler in this seventh embodiment is the same as described above with reference to Fig. 24. Also, this verification of the properness of the Enabler is common to the MakePAT, the MergePAT, the SplitPAT and the TransPAT.

[0320] Next, the eighth embodiment of the email access control scheme according to the present invention will be described in detail.

[0321] In this eighth embodiment, the OID is given by a real email address.

[0322] The PAT is an information comprising two or more real email addresses, the holder index, the validity period, the transfer control flag and the PAT processing device identifier (or the identifier of the PAT processing object on the network), which is signed using a secret key of the PAT processing device (or the PAT processing object on the network).

[0323] Here, one of the real email addresses is a holder email address of this PAT, where the change of the information contained in the PAT such as an addition of email address to the PAT, a deletion of email address from the PAT, a change of the validity period in the PAT, a change of the transfer control flag value in the PAT, etc., can be made by presenting the holder email address and an Enabler containing the holder email address to the PAT processing device (or the PAT processing object on the network).

[0324] On the other hand, the email addresses other than the holder email address that are contained in the PAT are all member email addresses, where a change

of the information contained in the PAT cannot be made even when the member email address and an Enabler containing the member email address are presented to the PAT processing device (or the PAT processing object on the network).

[0325] The holder index is a numerical data for identifying the holder email address, which is defined to take a value 1 when the holder email address is a top email address in the email address list formed from the holder email address and the member email addresses, a value 2 when the holder email address is a second email address from the top of the email address list, or a value n when the holder email address is an n-th email address from the top of the email address list.

[0326] The transfer control flag value is defined to take either 0 or 1.

[0327] The holder email address is defined to be a real email address which is written at a position specified by the holder index in the email address list. The member email addresses are defined to be all the email addresses other than the holder email address.

[0328] The validity period is defined by any one or combination of the number of times for which the PAT is available, the absolute time (UTC) by which the PAT becomes unavailable, the absolute time (UTC) by which the PAT becomes available, and the relative time (lifETIME) since the PAT becomes available until it becomes unavailable.

[0329] The identifier of the PAT processing device (or the PAT processing object on the network) is defined as a serial number of the PAT processing device (or an distinguished name of the PAT processing object on the network). The secret key of the PAT processing device (or the PAT processing object on the network) is defined to be uniquely corresponding to the identifier.

[0330] Also, in this eighth embodiment, an Enabler is defined as an identifier corresponding to the real email address. The Enabler is an information comprising a character string uniquely indicating that it is an Enabler and a real email address itself, which is signed using the secret key of the PAT processing device or the PAT processing object on the network.

[0331] The generation of the PAT in this eighth embodiment is carried out as follows.

[0332] Here, a directory will be described as an example of the PAT processing object on the network. The directory manages the real email address and the disclosed information of the user in correspondence, and outputs the PAT upon receiving the search conditions presented from an arbitrary user.

[0333] The user transmits the real email address and the search conditions to the directory. Then, the directory acquires all the real email addresses which uniquely correspond to the disclosed information that satisfies these search conditions. Then, the directory generates a real email address list from the real email address of the user who presented the search conditions and all the real email addresses acquired as a

search result. Then, the directory appends the holder index value, the validity period value, the transfer control flag value, and the distinguished name of the directory to the real email address list. Finally, the directory signs the resulting data using a secret key of the directory, and transmits it as the PAT to the user who presented the search conditions.

[0334] Next, the email access control in this eighth embodiment is carried out as follows.

[0335] The sender specifies the real email address of the sender in From: line, and "[PAT]@[real domain of sender]" in To: line of a mail.

[0336] The SCS acquires an email received by an MTA (Message Transfer Agent) such as SMTP (Simple Mail Transfer Protocol), and carries out the authentication by the following procedure.

(1) The signature of the PAT is verified using the public key of the PAT.

When the PAT is found to have been altered, the email is discarded and the processing is terminated.

When the PAT is found to have been not altered, the following processing (2) is executed.

(2) The search is carried out by presenting the sender's real email address to the PAT.

When a real email address that completely matches with the sender's real email address is not contained in the PAT, the email is discarded and the processing is terminated.

When a real email address that completely matches with the sender's real email address is contained in the PAT, the following processing (3) is executed.

(3) The validity period value of the PAT is evaluated.

When the PAT is outside the validity period, the email is discarded and the processing is terminated.

When the PAT is within the validity period, the following processing (4) is executed.

(4) Whether or not to authenticate the sender is determined by referring to the transfer control flag value of the PAT.

When the value is 1, the challenge/response authentication between the SCS and the sender is carried out, and the signature of the sender is verified. When the signature is valid, the recipient is specified and the PAT is attached. When the signature is invalid, the email is discarded and the processing is terminated.

When the value is 0, the recipient is specified and the PAT is attached without executing the challenge/response authentication.

[0337] An exemplary challenge/response authentication between the SCS and the sender in this eighth embodiment can be carried out as follows.

[0338] First, the SCS generates an arbitrary informa-

tion such as a timestamp, for example, and transmits the generated information to the sender.

[0339] Then, the sender generates the secret key and the public key, signs the received information using the secret key, and transmits it along with the public key.

[0340] The SCS then verifies the signature of the received information using the public key presented from the sender. When the signature is valid, the recipient is specified and the PAT is attached. When the signature is invalid, the email is discarded and the processing is terminated.

[0341] The specifying of the recipient and the attaching of the PAT at the SCS in this eighth embodiment can be carried out as follows.

[0342] First, the SCS carries out the search by presenting the sender's real email address to the PAT, so as to acquire all the real email addresses which do not completely match the sender's real email address. Then, all these acquired real email addresses are specified as recipient's real email addresses.

[0343] Next, the SCS attaches the PAT to an arbitrary position in the email in order to transmit the PAT to all the recipient's email addresses so as to be able to realize the bidirectional communications. Finally, the SCS gives the email to the MTA.

[0344] The receiving refusal with respect to the PAT at the SCS in this eighth embodiment can be carried out as follows.

[0345] Receiving refusal setting: The bidirectional authentication is carried out by an arbitrary means between the user and the SCS 5. Then, the user transmits a registration command, his/her own real email address, and arbitrary PATs to the SCS 5. Then, the SCS 5 next verifies the signature of each received PAT using a public key of the ADS. Those PATs with the invalid signature are discarded by the SCS 5. When the signature is valid, the SCS 5 carries out the search by presenting the received real email address to each PAT. For each of those PATs which contain the real email address that completely matches with the received real email address, the SCS 5 presents the registration command and the PAT to the storage device such that the PAT is registered into the storage device. Those PATs which do not contain the real email address that completely matches with the received real email address are discarded by the SCS 5 without storing them into the storage device.

[0346] Receiving refusal execution: The SCS 5 carries out the search by presenting the PAT to the storage device. When a PAT that completely matches the presented PAT is registered in the storage device, the mail is discarded. When a PAT that completely matches the present PAT is not registered in the storage device, the mail is not discarded.

[0347] Receiving refusal cancellation: The bidirectional authentication is carried out by an arbitrary means between the user and the SCS 5. Then, the user presents his/her own real email address to the SCS 5.

Then, the SCS 5 next presents the presented real email address as a search condition to the storage device and acquire all the PATs that contain the presented real email address, and then presents all the acquired PATs to the user. Then, the user selects all the PATs for which the receiving refusal is to be cancelled by referring to all the PATs presented from the SCS 5, and transmits all the selected PATs along with a deletion command to the SCS 5. Upon receiving the deletion command and all the PATs for which the receiving refusal is to be cancelled, the SCS 5 presents the deletion command and all the PATs received from the user to the storage device, such that all the received PATs are deleted from the storage device.

[0348] The editing of the PAT in this eighth embodiment can be carried out as follows.

[0349] The MakePAT, the MergePAT, the SplitPAT, and the TransPAT processings for the PAT using real email addresses as its elements can be obtained from the the MakePAT, the MergePAT, the SplitPAT, and the TransPAT processings for the PAT using AIDs as its elements described above, by replacing the AID by the real email address and the Enabler of AID by the Enabler of real email address.

[0350] A Null operator is an information comprising a data which is uniquely indicating that it is Null and which has a format of the real email address, which is signed by the secret key of the PAT processing device or the PAT processing object on the network.

[0351] Similarly, the God operator is an information comprising a data which is uniquely indicating that it is God and which has a format of the real email address, which is signed by the secret key of the PAT processing device or the PAT processing object on the network.

[0352] The Enabler of Null operator is an information comprising a data which is uniquely indicating that it is Enabler and the Null operator itself, which is signed by the secret key of the PAT processing device or the PAT processing object on the network.

[0353] The processings involving the Null operator and the God operator can be obtained from the processings for the PAT using AIDs as its elements described above, by replacing the AID by the real email address, the Enabler of AID by the Enabler of real email address, the Null-AID by the Null operator, the God-AID by the God operator, and the Enabler of Null-AID by the Enabler of Null operator.

[0354] As described, according to the present invention, a PAT is used for verifying the access right of a sender and the email access control among users is carried out when the verification result is valid, so that it becomes possible to disclose the information indicative of characteristics of a user while concealing the true identification of a user and carrying out communications appropriately according to this disclosed information while preventing conventionally possible attacks from a third person. In addition, even when a recipient receives an attack from a sender who maliciously utilizes the

anonymity, damages of a recipient due to that attack can be minimized.

[0355] Also, according to the present invention, the generation and the content change of the personalized access ticket can be made by the initiative of a user by using an AID assigned to each user and an Enabler defined in correspondence to the AID, so that it becomes possible to appropriately manage information such as that of a point of contact of each member of the group communication (mailing list, etc.) which changes dynamically.

[0356] Also, according to the present invention, a Null-AID and an Enabler of Null-AID can be introduced in order to carry out the generation of a new PAT (Make-PAT) and the merging of PATs (MergePAT) without giving the member AID and the Enabler of the member AID to the holder of the PAT, so that it becomes possible to prevent the pretending using the member AID.

[0357] Also, according to the present invention, the Null-AID can be used only as the holder AID of the PAT (the Null-AID cannot be used as the member AID), that is $\text{PAT} < \text{AID}_{\text{Null}} | \text{AID}_{\text{member1}}, \text{AID}_{\text{member2}}, \dots, \text{AID}_{\text{memberN}} >$ is allowed, but $\text{PAT} < \text{AID}_{\text{holder}} | \text{AID}_{\text{Null}}, \text{AID}_{\text{member1}}, \text{AID}_{\text{member2}}, \dots, \text{AID}_{\text{memberN}} >$ is not allowed, so that the holder of $\text{PAT} < \text{AID}_{\text{holder}} | \text{AID}_{\text{member}} >$ cannot produce $\text{PAT} < \text{AID}_{\text{Null}} | \text{AID}_{\text{member}} >$ from this $\text{PAT} < \text{AID}_{\text{holder}} | \text{AID}_{\text{member}} >$ as long as the holder does not know Enabler of $\text{AID}_{\text{member}}$.

[0358] Also, according to the present invention, a God-AID can be introduced in order to set up a read only attribute to the PAT, so that it becomes possible to fix the participants in the group communication.

[0359] Also, according to the present invention, the link information for uniquely specifying the AID can be introduced and the PAT can be given in terms of the link information such that the PAT does not contain the AID itself, so that it becomes possible to realize the receiving refusal function without using the AID itself.

[0360] It is to be noted that, besides those already mentioned above, many modifications and variations of the above embodiments may be made without departing from the novel and advantageous features of the present invention. Accordingly, all such modifications and variations are intended to be included within the scope of the appended claims.

Claims

1. A method of email access control, comprising the steps of:

receiving a personalized access ticket containing a sender's identification and a recipient's identification in correspondence, which is presented by a sender who wishes to send an email to a recipient so as to specify the recipient as an intended destination of the email, at a secure communication service for connecting

communications between the sender and the receiver; and

controlling accesses between the sender and the recipient by verifying an access right of the sender with respect to the recipient according to the personalized access ticket at the secure communication service.

2. The method of claim 1, wherein at the controlling step the secure communication service authenticates the personalized access ticket presented by the sender, and refuses a delivery of the email when the personalized access ticket presented by the sender has been altered.
3. The method of claim 2, wherein the personalized access ticket is signed by a secret key of a secure processing device which issued the personalized access ticket, and at the controlling step the secure communication service authenticates the personalized access ticket by verifying a signature of the secure processing device in the personalized access ticket using a public key of the secure processing device.
4. The method of claim 1, wherein at the receiving step the secure communication service also receives the sender's identification presented by the sender along with the personalized access ticket, and at the controlling step the secure communication service checks whether the sender's identification presented by the sender is contained in the personalized access ticket presented by the sender, and refuses a delivery of the email when the sender's identification presented by the sender is not contained in the personalized access ticket presented by the sender.
5. The method of claim 1, wherein the personalized access ticket also contains a validity period indicating a period for which the personalized access ticket is valid, and at the controlling step the secure communication service checks the validity period contained in the personalized access ticket presented by the sender and refuses a delivery of the email when the personalized access ticket presented by the sender contains the validity period that has already been expired.

6. The method of claim 5, wherein the validity period of the personalized access ticket is set by a trusted third party.

7. The method of claim 1, further comprising the step of:

issuing the personalized access ticket to the sender at a directory service for managing an

identification of each registrant and a disclosed information of each registrant which has a lower secrecy than a personal information, in a state which is accessible for search by unspecified many, in response to search conditions specified by the sender, by using an identification of a registrant whose disclosed information matches the search conditions as the recipient's identification and the sender's identification specified by the sender along with the search conditions.

8. The method of claim 1, further comprising the step of:

registering in advance the personalized access ticket containing an identification of a specific user from which a delivery of emails to a specific registrant is to be refused as the sender's identification and an identification of the specific registrant as the recipient's identification, at the secure communication service; wherein the controlling step the secure communication service refuses a delivery of the email from the sender when the personalized access ticket presented by the sender is registered therein in advance at the registering step.

9. The method of claim 8, further comprising the step of:

deleting the personalized access ticket registered at the secure communication service upon request from the specific registrant who registered the personalized access ticket at the registering step.

10. The method of claim 1, wherein the personalized access ticket also contains a transfer control flag indicating whether or not the sender should be authenticated by the secure communication service, and at the controlling step, when the transfer control flag contained in the personalized access ticket indicates that the sender should be authenticated, the secure communication service authenticates the sender's identification presented by the sender and refuses a delivery of the email when an authentication of the sender's identification fails.

11. The method of claim 10, wherein the authentication of the sender's identification is realized by a challenge/response procedure between the sender and the secure communication service.

12. The method of claim 10, wherein the transfer control flag of the personalized access ticket is set by a trusted third party.

13. The method of claim 1, wherein the sender's identification and the recipient's identification in the personalized access ticket are given by real email addresses of the sender and the recipient.

14. The method of claim 1, wherein the sender's identification and the recipient's identification in the personalized access ticket are given by anonymous identifications of the sender and the recipient, where an anonymous identification of each user contains at least one fragment of an official identification of each user by which each user is uniquely identifiable by a certification authority.

15. The method of claim 14, wherein the anonymous identification of each user is an information containing the at least one fragment of the official identification of each user which is signed by the certification authority using a secret key of the certification authority.

16. The method of claim 14, wherein the official identification of each user is a character string uniquely assigned to each user by the certification authority and a public key of each user which are signed by a secret key of the certification authority.

17. The method of claim 14, further comprising the step of:

probabilistically identifying an identity of the sender by reconstructing the official identification of the sender by judging identity of a plurality of anonymous identifications of the sender contained in a plurality of personalized access tickets used by the sender.

18. The method of claim 1, wherein an anonymous identification of each user that contains at least one fragment of an official identification of each user by which each user is uniquely identifiable by a certification authority and a link information of each anonymous identification by which each anonymous identification can be uniquely identified are defined, and the sender's identification and the recipient's identification in the personalized access ticket are given by a link information of the anonymous identification of the sender and a link information of the anonymous identification of the recipient.

19. The method of claim 1, wherein the link information of each anonymous identification is an identifier uniquely assigned to each anonymous identification by the certification authority.

20. The method of claim 18, further comprising the step of:

p robabilistically identifying an identity of the sender by reconstructing the official identification of the sender by judging identity of a plurality of anonymous identifications of the sender corresponding to the link information contained in a plurality of personalized access tickets used by the sender.

21. The method of claim 1, wherein the personalized access ticket contains a single sender's identification and a single recipient's identification in 1-to-1 correspondence. 10

22. The method of claim 1, wherein the personalized access ticket contains a single sender's identification and a plurality of recipient's identifications in 1-to-N correspondence, where N is an integer greater than 1. 15

23. The method of claim 22, wherein one identification among the single sender's identification and the plurality of recipient's identifications is a holder identification for identifying a holder of the personalized access ticket while other identifications among the single sender's identification and the plurality of recipient's identifications are member identifications for identifying members of a group to which the holder belongs. 20

24. The method of claim 23, further comprising the step of: 30

issuing an identification of each user and an enabler of the identification of each user indicating a right to change the personalized access ticket containing the identification of each user as the holder identification, to each user at a certification authority, such that prescribed processing on the personalized access ticket can be carried out at a secure processing device only by a user who presented both the holder identification contained in the personalized access ticket and the enabler corresponding to the holder identification to the secure processing device. 35

25. The method of claim 24, wherein the certification authority issues the enabler of the identification of each user as an information indicating that it is the enabler and the identification of each user itself which are signed by a secret key of the certification authority. 50

26. The method of claim 24, wherein the prescribed processing includes a generation of a new personalized access ticket, a merging of a plurality of personalized access tickets, a splitting of one personalized access ticket into a plurality of person- 45

alized access tickets, a changing of the holder of the personalized access ticket, changing of a validity period of the personalized access ticket, and a changing of a transfer control flag of the personalized access ticket. 5

27. The method of claim 26, wherein a special identification and a special enabler corresponding to the special identification which are known to all users are defined such that the generation of a new personalized access ticket and the changing of the holder of the personalized access ticket can be carried out by the holder of the personalized access ticket by using the special identification and the special enabler without using an enabler of a member identification. 10

28. The method of claim 27, wherein the special identification is defined to be capable of being used only as the holder identification of the personalized access ticket. 15

29. The method of claim 26, wherein a special identification which is known to all users is defined such that a read only attribute can be set to the personalized access ticket by using the special identification. 20

30. The method of claim 1, wherein at the controlling step, when the access right of the sender with respect to the recipient is verified according to the personalized access ticket, the secure communication service takes out the recipient's identification from the personalized access ticket by using the sender's identification presented by the sender, converts the mail by using a taken out recipient's identification into a format that can be interpreted by a mail transfer function for actually carrying out a mail delivery processing, and gives the mail after conversion to the mail transfer function by attaching the personalized access ticket. 25

31. A method of email access control, comprising the steps of: 30

defining an official identification of each user by which each user is uniquely identifiable by a certification authority, and an anonymous identification of each user containing at least one fragment of the official identification; and identifying each user by the anonymous identification of each user in communications for emails on a communication network. 35

32. The method of claim 31, wherein the anonymous identification of each user is an information containing the at least one fragment of the official identification of each user which is signed by the 50

certification authority using a secret key of the certification authority.

33. The method of claim 31, wherein the official identification of each user is a character string uniquely assigned to each user by the certification authority and a public key of each user which are signed by a secret key of the certification authority. 5

34. The method of claim 31, further comprising the steps of: 10

receiving a personalized access ticket containing a sender's anonymous identification and a recipient's anonymous identification in correspondence, which is presented by a sender who wishes to send an email to a recipient so as to specify the recipient as an intended destination of the email, at a secure communication service for connecting communications between the sender and the receiver; and 15
controlling accesses between the sender and the recipient by verifying an access right of the sender with respect to the recipient according to the personalized access ticket at the secure communication service. 20

35. The method of claim 34, further comprising the step of: 25

probabilistically identifying an identity of the sender at the secure communication service by reconstructing the official identification of the sender while judging identity of a plurality of anonymous identifications of the sender contained in a plurality of personalized access tickets used by the sender. 30

36. The method of claim 31, wherein the defining step also defines a link information of each anonymous identification by which each anonymous identification can be uniquely identified, and each anonymous identification also contains the link information of each anonymous identification. 35

37. The method of claim 36, wherein the link information of each anonymous identification is an identifier uniquely assigned to each anonymous identification by the certification authority. 40

38. The method of claim 36, further comprising the steps of: 45

receiving a personalized access ticket containing a link information of a sender's anonymous identification and a link information of a recipient's anonymous identification in correspondence, which is presented by a sender who 50

wishes to send an email to a recipient so as to specify the recipient as an intended destination of the email, at a secure communication service for connecting communications between the sender and the receiver; and
controlling accesses between the sender and the recipient by verifying an access right of the sender with respect to the recipient according to the personalized access ticket at the secure communication service. 55

39. The method of claim 38, further comprising the step of:

probabilistically identifying an identity of the sender by reconstructing the official identification of the sender while judging identity of a plurality of anonymous identifications of the sender corresponding to the link information contained in a plurality of personalized access tickets used by the sender. 60

40. A communication system realizing email access control, comprising:

a communication network to which a plurality of user terminals are connected; and
a secure communication service device for connecting communications between the sender and the receiver on the communication network, by receiving a personalized access ticket containing a sender's identification and a recipient's identification in correspondence, which is presented by a sender who wishes to send an email to a recipient so as to specify the recipient as an intended destination of the email, and controlling accesses between the sender and the recipient by verifying an access right of the sender with respect to the recipient according to the personalized access ticket. 65

41. The system of claim 40, wherein the secure communication service device authenticates the personalized access ticket presented by the sender, and refuses a delivery of the email when the personalized access ticket presented by the sender has been altered. 70

42. The system of claim 41, further comprising:

a secure processing device for issuing the personalized access ticket which is signed by a secret key of the secure processing device; wherein the secure communication service device authenticates the personalized access ticket by verifying a signature of the secure processing device in the personalized access ticket using a public key of the secure process- 75

ing device.

43. The system of claim 40, wherein the secure communication service device also receives the sender's identification presented by the sender along with the personalized access ticket, checks whether the sender's identification presented by the sender is contained in the personalized access ticket presented by the sender, and refuses a delivery of the email when the sender's identification presented by the sender is not contained in the personalized access ticket presented by the sender.

44. The system of claim 40, wherein the personalized access ticket also contains a validity period indicating a period for which the personalized access ticket is valid, and the secure communication service device checks the validity period contained in the personalized access ticket presented by the sender and refuses a delivery of the email when the personalized access ticket presented by the sender contains the validity period that has already been expired.

45. The system of claim 44, further comprising: a trusted third party for setting the validity period of the personalized access ticket.

46. The system of claim 40, further comprising: a directory service device for managing an identification of each registrant and a disclosed information of each registrant which has a lower secrecy than a personal information, in a state which is accessible for search by unspecified many, and issuing the personalized access ticket to the sender in response to search conditions specified by the sender, by using an identification of a registrant whose disclosed information matches the search conditions as the recipient's identification and the sender's identification specified by the sender along with the search conditions.

47. The system of claim 40, wherein the secure communication service device registers in advance the personalized access ticket containing an identification of a specific user from which a delivery of emails to a specific registrant is to be refused as the sender's identification and an identification of the specific registrant as the recipient's identification, and refuses a delivery of the email from the sender when the personalized access ticket presented by the sender is registered therein in advance.

48. The system of claim 47, wherein the secure communication service device deletes the personalized access ticket registered therein upon request from the specific registrant who registered the personalized access ticket.

49. The system of claim 40, wherein the personalized access ticket also contains a transfer control flag indicating whether or not the sender should be authenticated by the secure communication service, and when the transfer control flag contained in the personalized access ticket indicates that the sender should be authenticated, the secure communication service device authenticates the sender's identification presented by the sender and refuses a delivery of the email when an authentication of the sender's identification fails.

50. The system of claim 49, wherein the authentication of the sender's identification is realized by a challenge/response procedure between the sender and the secure communication service device.

51. The system of claim 49, further comprising a trusted third party for setting the transfer control flag of the personalized access ticket.

52. The system of claim 40, wherein the sender's identification and the recipient's identification in the personalized access ticket are given by real email addresses of the sender and the recipient.

53. The system of claim 40, further comprising: a certification authority device for issuing an anonymous identification of each user which contains at least one fragment of an official identification of each user by which each user is uniquely identifiable by the certification authority device; wherein the sender's identification and the recipient's identification in the personalized access ticket are given by anonymous identifications of the sender and the recipient.

54. The system of claim 53, wherein the anonymous identification of each user is an information containing the at least one fragment of the official identification of each user which is signed by the certification authority device using a secret key of the certification authority device.

55. The system of claim 53, wherein the official identification of each user is a character string uniquely assigned to each user by the certification authority device and a public key of each user which are signed by a secret key of the certification authority device.

56. The system of claim 53, wherein the secure com-

munication service device probabilistically identifies an identity of the sender by reconstructing the official identification of the sender while judging identity of a plurality of anonymous identifications of the sender contained in a plurality of personalized access tickets used by the sender.

57. The system of claim 40, further comprising:

a certification authority device for issuing an anonymous identification of each user which contains at least one fragment of an official identification of each user by which each user is uniquely identifiable by the certification authority device and a link information of each anonymous identification by which each anonymous identification can be uniquely identified; wherein the sender's identification and the recipient's identification in the personalized access ticket are given by a link information of the anonymous identification of the sender and a link information of the anonymous identification of the recipient.

58. The system of claim 57, wherein the link information of each anonymous identification is an identifier uniquely assigned to each anonymous identification by the certification authority device.

59. The system of claim 57, wherein the secure communication service device probabilistically identifies an identity of the sender by reconstructing the official identification of the sender while judging identity of a plurality of anonymous identifications of the sender corresponding to the link information contained in a plurality of personalized access tickets used by the sender.

60. The system of claim 40, wherein the personalized access ticket contains a single sender's identification and a single recipient's identification in 1-to-1 correspondence.

61. The system of claim 40, wherein the personalized access ticket contains a single sender's identification and a plurality of recipient's identifications in 1-to-N correspondence, where N is an integer greater than 1.

62. The system of claim 61, wherein one identification among the single sender's identification and the plurality of recipient's identifications is a holder identification for identifying a holder of the personalized access ticket while other identifications among the single sender's identification and the plurality of recipient's identifications are member identifications for identifying members of a group to which the holder belongs.

63. The system of claim 62, further comprising:

a certification authority device for issuing to each user an identification of each user and an enabler of the identification of each user indicating a right to change the personalized access ticket containing the identification of each user as the holder identification; and a secure processing device at which prescribed processing on the personalized access ticket can be carried out only by a user who presented both the holder identification contained in the personalized access ticket and the enabler corresponding to the holder identification to the secure processing device.

64. The system of claim 63, wherein the certification authority device issues the enabler of the identification of each user as an information indicating that it is the enabler and the identification of each user itself which are signed by a secret key of the certification authority device.

65. The system of claim 63, wherein the prescribed processing includes a generation of a new personalized access ticket, a merging of a plurality of personalized access tickets, a splitting of one personalized access ticket into a plurality of personalized access tickets, a changing of the holder of the personalized access ticket, changing of a validity period of the personalized access ticket, and a changing of a transfer control flag of the personalized access ticket.

66. The system of claim 65, wherein a special identification and a special enabler corresponding to the special identification which are known to all users are defined such that the generation of a new personalized access ticket and the changing of the holder of the personalized access ticket can be carried out by the holder of the personalized access ticket by using the special identification and the special enabler without using an enabler of a member identification.

67. The system of claim 66, wherein the special identification is defined to be capable of being used only as the holder identification of the personalized access ticket.

68. The system of claim 65, wherein a special identification which is known to all users is defined such that a read only attribute can be set to the personalized access ticket by using the special identification.

69. The system of claim 40, wherein when the access right of the sender with respect to the recipient is

verified according to the personalized access ticket, the secure communication service device takes out the recipient's identification from the personalized access ticket by using the sender's identification presented by the sender, converts the mail by using a taken out recipient's identification into a format that can be interpreted by a mail transfer function for actually carrying out a mail delivery processing, and gives the mail after conversion to the mail transfer function by attaching the personalized access ticket.

70. A communication system realizing email access control, comprising:

a certification authority device for defining an official identification of each user by which each user is uniquely identifiable by the certification authority device, and an anonymous identification of each user which contains at least one fragment of the official identification; and

a communication network on which each user is identified by the anonymous identification of each user in communications for emails on the communication network.

71. The system of claim 70, wherein the anonymous identification of each user is an information containing the at least one fragment of the official identification of each user which is signed by the certification authority device using a secret key of the certification authority device.

72. The system of claim 70, wherein the official identification of each user is a character string uniquely assigned to each user by the certification authority device and a public key of each user which are signed by a secret key of the certification authority device.

73. The system of claim 70, further comprising:

a secure communication service device for connecting communications between the sender and the receiver on the communication network, by receiving a personalized access ticket containing a sender's anonymous identification and a recipient's anonymous identification in correspondence, which is presented by a sender who wishes to send an email to a recipient so as to specify the recipient as an intended destination of the email, and controlling accesses between the sender and the recipient by verifying an access right of the sender with respect to the recipient according to the personalized access ticket.

74. The system of claim 73, wherein the secure communication service device probabilistically identifies an identity of the sender by reconstructing the official identification of the sender while judging identity of a plurality of anonymous identifications of the sender contained in a plurality of personalized access tickets used by the sender.

75. The system of claim 70, wherein the certification authority device also defines a link information of each anonymous identification by which each anonymous identification can be uniquely identified, and each anonymous identification also contains the link information of each anonymous identification.

76. The system of claim 75, wherein the link information of each anonymous identification is an identifier uniquely assigned to each anonymous identification by the certification authority device.

77. The system of claim 75, further comprising:

a secure communication service device for connecting communications between the sender and the receiver on the communication network, by receiving a personalized access ticket containing a link information of a sender's anonymous identification and a link information of a recipient's anonymous identification in correspondence, which is presented by a sender who wishes to send an email to a recipient so as to specify the recipient as an intended destination of the email, and controlling accesses between the sender and the recipient by verifying an access right of the sender with respect to the recipient according to the personalized access ticket.

78. The system of claim 77, wherein the secure communication service device probabilistically identifies an identity of the sender by reconstructing the official identification of the sender while judging identity of a plurality of link informations of anonymous identifications of the sender contained in a plurality of personalized access tickets used by the sender.

79. A secure communication service device for use in a communication system realizing email access control, comprising:

a computer hardware; and

a computer software for causing the computer hardware to connect communications between the sender and the receiver, by receiving a personalized access ticket containing a sender's identification and a recipient's identification in correspondence, which is presented by a

sender who wishes to send an email to a recipient so as to specify the recipient as an intended destination of the email, and controlling accesses between the sender and the recipient by verifying an access right of the sender with respect to the recipient according to the personalized access ticket.

5

specific registrant is to be refused as the sender's identification and an identification of the specific registrant as the recipient's identification, at the secure communication service device, and refuse a delivery of the email from the sender when the personalized access ticket presented by the sender is registered at the secure communication service device in advance.

80. The secure communication service device of claim 79,
wherein the computer software causes the computer hardware to authenticate the personalized access ticket presented by the sender, and refuse a delivery of the email when the personalized access ticket presented by the sender has been altered.

10

85. The secure communication service device of claim 84,
wherein the computer software causes the computer hardware to delete the personalized access ticket registered at the secure communication service device upon request from the specific registrant who registered the personalized access ticket.

81. The secure communication service device of claim 80,
wherein the personalized access ticket is signed by a secret key of a secure processing device which issued the personalized access ticket, and the computer software causes the computer hardware to authenticate the personalized access ticket by verifying a signature of the secure processing device in the personalized access ticket using a public key of the secure processing device.

15

86. The secure communication service device of claim 79,
wherein the personalized access ticket also contains a transfer control flag indicating whether or not the sender should be authenticated by the secure communication service device, and when the transfer control flag contained in the personalized access ticket indicates that the sender should be authenticated, the computer software causes the computer hardware to authenticate the sender's identification presented by the sender and refuse a delivery of the email when an authentication of the sender's identification fails.

82. The secure communication service device of claim 79,
wherein the computer software causes the computer hardware to also receive the sender's identification presented by the sender along with the personalized access ticket, check whether the sender's identification presented by the sender is contained in the personalized access ticket presented by the sender, and refuse a delivery of the email when the sender's identification presented by the sender is not contained in the personalized access ticket presented by the sender.

20

87. The secure communication service device of claim 86,
wherein the computer software causes the computer hardware to realize the authentication of the sender's identification by a challenge/response procedure between the sender and the secure communication service device.

83. The secure communication service device of claim 79,
wherein the personalized access ticket also contains a validity period indicating a period for which the personalized access ticket is valid, and the computer software causes the computer hardware to check the validity period contained in the personalized access ticket presented by the sender and refuse a delivery of the email when the personalized access ticket presented by the sender contains the validity period that has already been expired.

25

88. The secure communication service device of claim 79,
wherein the sender's identification and the recipient's identification in the personalized access ticket are given by anonymous identifications of the sender and the recipient, where an anonymous identification of each user contains at least one fragment of an official identification of each user by which each user is uniquely identifiable by a certification authority, and the computer software also causes the computer hardware to probabilistically identify an identity of the sender by reconstructing the official identification of the sender by judging identity of a plurality of anonymous identifications of the sender contained in a plurality of personalized access tickets used by the sender.

84. The secure communication service device of claim 79,
wherein the computer software causes the computer hardware to register in advance the personalized access ticket containing an identification of a specific user from which a delivery of emails to a

30

35

40

45

50

55

89. The secure communication service device of claim 79,

wherein an anonymous identification of each user that contains at least one fragment of an official identification of each user by which each user is uniquely identifiable by a certification authority and a link information of each anonymous identification by which each anonymous identification can be uniquely identified are defined, the sender's identification and the recipient's identification in the personalized access ticket are given by a link information of the anonymous identification of the sender and a link information of the anonymous identification of the recipient, and the computer software also causes the computer hardware to probabilistically identify an identity of the sender by reconstructing the official identification of the sender by judging identity of a plurality of anonymous identifications of the sender corresponding to the link information contained in a plurality of personalized access tickets used by the sender.

5

90. The secure communication service device of claim 79,
wherein when the access right of the sender with respect to the recipient is verified according to the personalized access ticket, the computer software causes the computer hardware to take out the recipient's identification from the personalized access ticket by using the sender's identification presented by the sender, convert the mail by using a taken out recipient's identification into a format that can be interpreted by a mail transfer function for actually carrying out a mail delivery processing, and give the mail after conversion to the mail transfer function by attaching the personalized access ticket.

20

91. A secure processing device for use in a communication system realizing email access control, comprising:
a computer hardware; and
a computer software for causing the computer hardware to receive a request for a personalized access ticket from a user, and issue a personalized access ticket containing a sender's identification and a recipient's identification in correspondence, which is signed by a secret key of the secure processing device.

25

92. A directory service device for use in a communication system realizing email access control, comprising:
a computer hardware; and
a computer software for causing the computer hardware to manage an identification of each registrant and a disclosed information of each registrant which has a lower secrecy than a

30

35

40

45

50

55

personal information, in a state which is accessible for search by unspecified many, and issue a personalized access ticket containing a sender's identification and a recipient's identification in correspondence, to the sender in response to search conditions specified by the sender, by using an identification of a registrant whose disclosed information matches the search conditions as the recipient's identification and the sender's identification specified by the sender along with the search conditions.

93. A certification authority device for use in a communication system realizing email access control, comprising:
a computer hardware; and
a computer software for causing the computer hardware to issue to each user an official identification of each user by which each user is uniquely identifiable by the certification authority device, and an anonymous identification of each user which contains at least one fragment of the official identification.

94. A certification authority device for use in a communication system realizing email access control, comprising:
a computer hardware; and
a computer software for causing the computer hardware to issue to each user an identification of each user and an enabler of the identification of each user indicating a right to change any personalized access ticket that contains the identification of each user as a holder identification, where the personalized access ticket generally contains a sender's identification and a plurality of recipient's identifications in correspondence, and one of the sender's identification and the recipient's identifications is a holder identification.

95. A secure processing device for use in a communication system realizing email access control, comprising:
a computer hardware; and
a computer software for causing the computer hardware to receive from a user a request for prescribed processing on a personalized access ticket containing a sender's identification and a plurality of recipient's identifications in correspondence, where one of the sender's identification and the recipient's identifications is a holder identification, and execute the prescribed processing on the personalized access ticket when the user presented both the holder

identification contained in the personalized access ticket and an enabler corresponding to the holder identification which indicates a right to change the personalized access ticket containing the identification of the user as the holder identification. 5

96. A computer usable medium having computer readable program code means embodied therein for causing a computer to function as a secure communication service device for use in a communication system realizing email access control, the computer readable program code means includes: 10

first computer readable program code means for causing said computer to receive a personalized access ticket containing a sender's identification and a recipient's identification in correspondence, which is presented by a sender who wishes to send an email to a recipient so as to specify the recipient as an intended destination of the email; and 15

second computer readable program code means for causing said computer to control accesses between the sender and the recipient by verifying an access right of the sender with respect to the recipient according to the personalized access ticket, so as to connect communications between the sender and the receiver on the communication network. 20

97. The computer usable medium of claim 96, the second computer readable program code means causes said computer to authenticate the personalized access ticket presented by the sender, and refuse a delivery of the email when the personalized access ticket presented by the sender has been altered. 25

98. The computer usable medium of claim 97, wherein the personalized access ticket is signed by a secret key of a secure processing device which issued the personalized access ticket, and the second computer readable program code means causes said computer to authenticate the personalized access ticket by verifying a signature of the secure processing device in the personalized access ticket using a public key of the secure processing device. 30

99. The computer usable medium of claim 96, wherein the first computer readable program code means causes said computer to also receive the sender's identification presented by the sender along with the personalized access ticket, and the second computer readable program code means causes said computer to check whether the sender's identification presented by the sender is contained in the personalized access ticket presented by the 35

sender and refuse a delivery of the email when the sender's identification presented by the sender is not contained in the personalized access ticket presented by the sender. 40

100. The computer usable medium of claim 96, wherein the personalized access ticket also contains a validity period indicating a period for which the personalized access ticket is valid, and the second computer readable program code means causes said computer to check the validity period contained in the personalized access ticket presented by the sender and refuse a delivery of the email when the personalized access ticket presented by the sender contains the validity period that has already been expired. 45

101. The computer usable medium of claim 96, wherein the second computer readable program code means causes said computer to register in advance the personalized access ticket containing an identification of a specific user from which a delivery of emails to a specific registrant is to be refused as the sender's identification and an identification of the specific registrant as the recipient's identification, at the secure communication service device, and refuse a delivery of the email from the sender when the personalized access ticket presented by the sender is registered at the secure communication service device in advance. 50

102. The computer usable medium of claim 101, wherein the second computer readable program code means causes said computer to delete the personalized access ticket registered at the secure communication service device upon request from the specific registrant who registered the personalized access ticket. 55

103. The computer usable medium of claim 96, wherein the personalized access ticket also contains a transfer control flag indicating whether or not the sender should be authenticated by the secure communication service device, and when the transfer control flag contained in the personalized access ticket indicates that the sender should be authenticated, the second computer readable program code means causes said computer to authenticate the sender's identification presented by the sender and refuse a delivery of the email when an authentication of the sender's identification fails. 60

104. The computer usable medium of claim 103, wherein the second computer readable program code means causes said computer to realize the authentication of the sender's identification by a challenge/response procedure between the sender and the secure communication service device. 65

105.The computer usable medium of claim 96, wherein the sender's identification and the recipient's identification in the personalized access ticket are given by anonymous identifications of the sender and the recipient, where an anonymous identification of each user contains at least one fragment of an official identification of each user by which each user is uniquely identifiable by a certification authority, and the second computer readable program code means also causes said computer to probabilistically identify an identity of the sender by reconstructing the official identification of the sender by judging identity of a plurality of anonymous identifications of the sender contained in a plurality of personalized access tickets used by the sender.

106.The computer usable medium of claim 96, wherein an anonymous identification of each user that contains at least one fragment of an official identification of each user by which each user is uniquely identifiable by a certification authority and a link information of each anonymous identification by which each anonymous identification can be uniquely identified are defined, the sender's identification and the recipient's identification in the personalized access ticket are given by a link information of the anonymous identification of the sender and a link information of the anonymous identification of the recipient, and the second computer readable program code means also causes said computer to probabilistically identify an identity of the sender by reconstructing the official identification of the sender by judging identity of a plurality of anonymous identifications of the sender corresponding to the link information contained in a plurality of personalized access tickets used by the sender.

107.The computer usable medium of claim 96, wherein when the access right of the sender with respect to the recipient is verified according to the personalized access ticket, the second computer readable program code means causes said computer to take out the recipient's identification from the personalized access ticket by using the sender's identification presented by the sender, convert the mail by using a taken out recipient's identification into a format that can be interpreted by a mail transfer function for actually carrying out a mail delivery processing, and give the mail after conversion to the mail transfer function by attaching the personalized access ticket.

108.A computer usable medium having computer readable program code means embodied therein for causing a computer to function as a secure processing device for use in a communication system realizing email access control, the computer

readable program code means includes:

first computer readable program code means for causing said computer to receive a request for a personalized access ticket from a user; and

second computer readable program code means for causing said computer to issue the personalized access ticket containing a sender's identification and a recipient's identification in correspondence, which is signed by a secret key of the secure processing device.

109.A computer usable medium having computer readable program code means embodied therein for causing a computer to function as a directory service device for use in a communication system realizing email access control, the computer readable program code means includes:

first computer readable program code means for causing said computer to manage an identification of each registrant and a disclosed information of each registrant which has a lower secrecy than a personal information, in a state which is accessible for search by unspecified many, and

second computer readable program code means for causing said computer to issue a personalized access ticket containing a sender's identification and a recipient's identification in correspondence, to the sender in response to search conditions specified by the sender, by using an identification of a registrant whose disclosed information matches the search conditions as the recipient's identification and the sender's identification specified by the sender along with the search conditions.

110.A computer usable medium having computer readable program code means embodied therein for causing a computer to function as a certification authority device for use in a communication system realizing email access control, the computer readable program code means includes:

first computer readable program code means for causing said computer to issue to each user an official identification of each user by which each user is uniquely identifiable by the certification authority device; and

second computer readable program code means for causing said computer to issue to each user an anonymous identification of each user which contains at least one fragment of the official identification.

111.A computer usable medium having computer read-

able program code means embodied therein for causing a computer to function as a certification authority device for use in a communication system realizing email access control, the computer readable program code means includes:

5

first computer readable program code means for causing said computer to issue to each user an identification of each user; and

10

second computer readable program code means for causing said computer to issue to each user an enabler of the identification of each user indicating a right to change any personalized access ticket that contains the identification of each user as a holder identification, where the personalized access ticket generally contains a sender's identification and a plurality of recipient's identifications in correspondence, and one of the sender's identification and the recipient's identifications is a holder identification.

15

20

112.A computer usable medium having computer readable program code means embodied therein for causing a computer to function as a secure processing device for use in a communication system realizing email access control, the computer readable program code means includes:

25

first computer readable program code means for causing said computer to receive from a user a request for prescribed processing on a personalized access ticket containing a sender's identification and a plurality of recipient's identifications in correspondence, where one of the sender's identification and the recipient's identifications is a holder identification; and

30

35

second computer readable program code means for causing said computer to execute the prescribed processing on the personalized access ticket when the user presented both the holder identification contained in the personalized access ticket and an enabler corresponding to the holder identification which indicates a right to change the personalized access ticket containing the identification of the user as the holder identification.

40

45

50

55

51

FIG.1

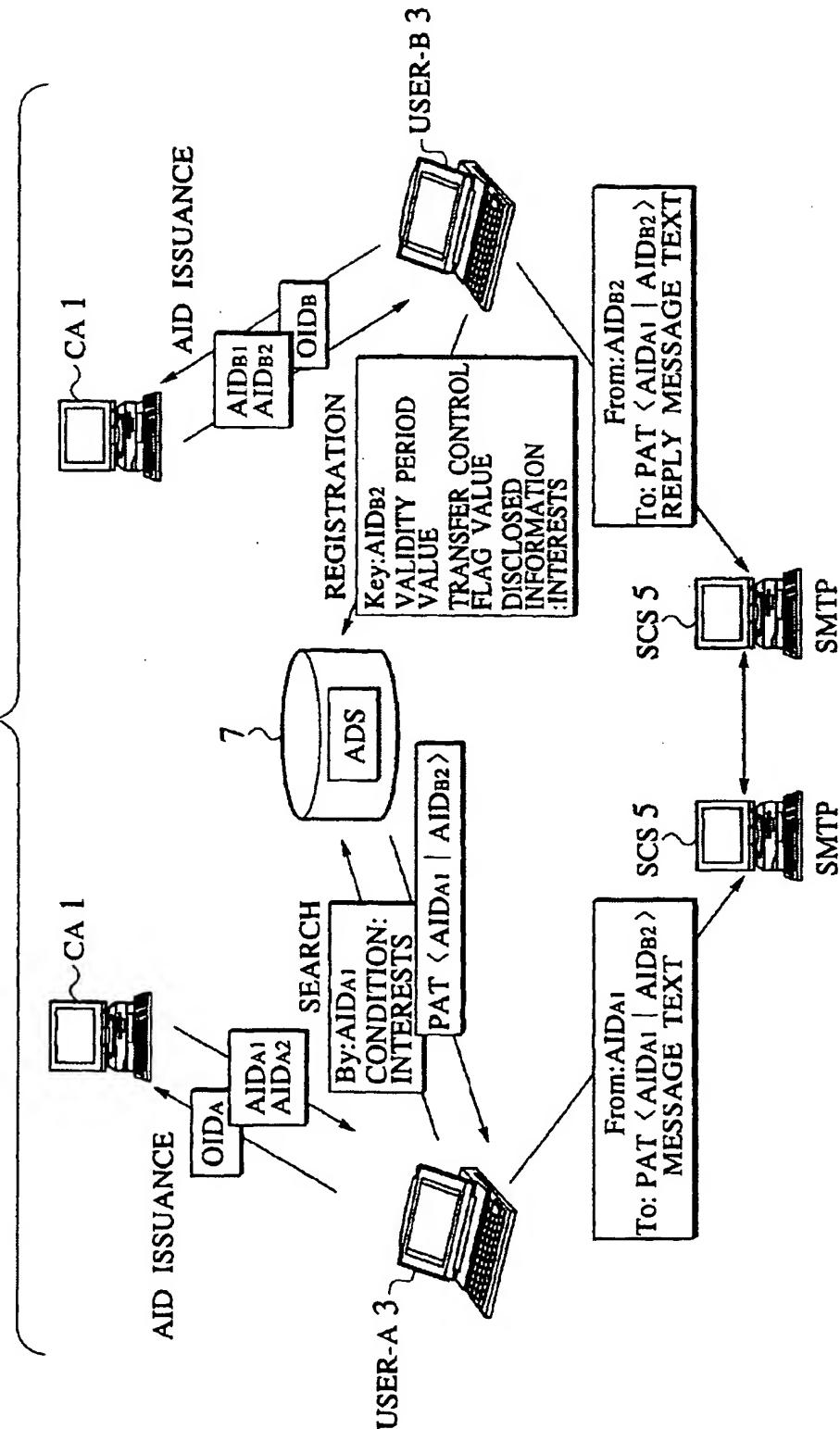


FIG.2

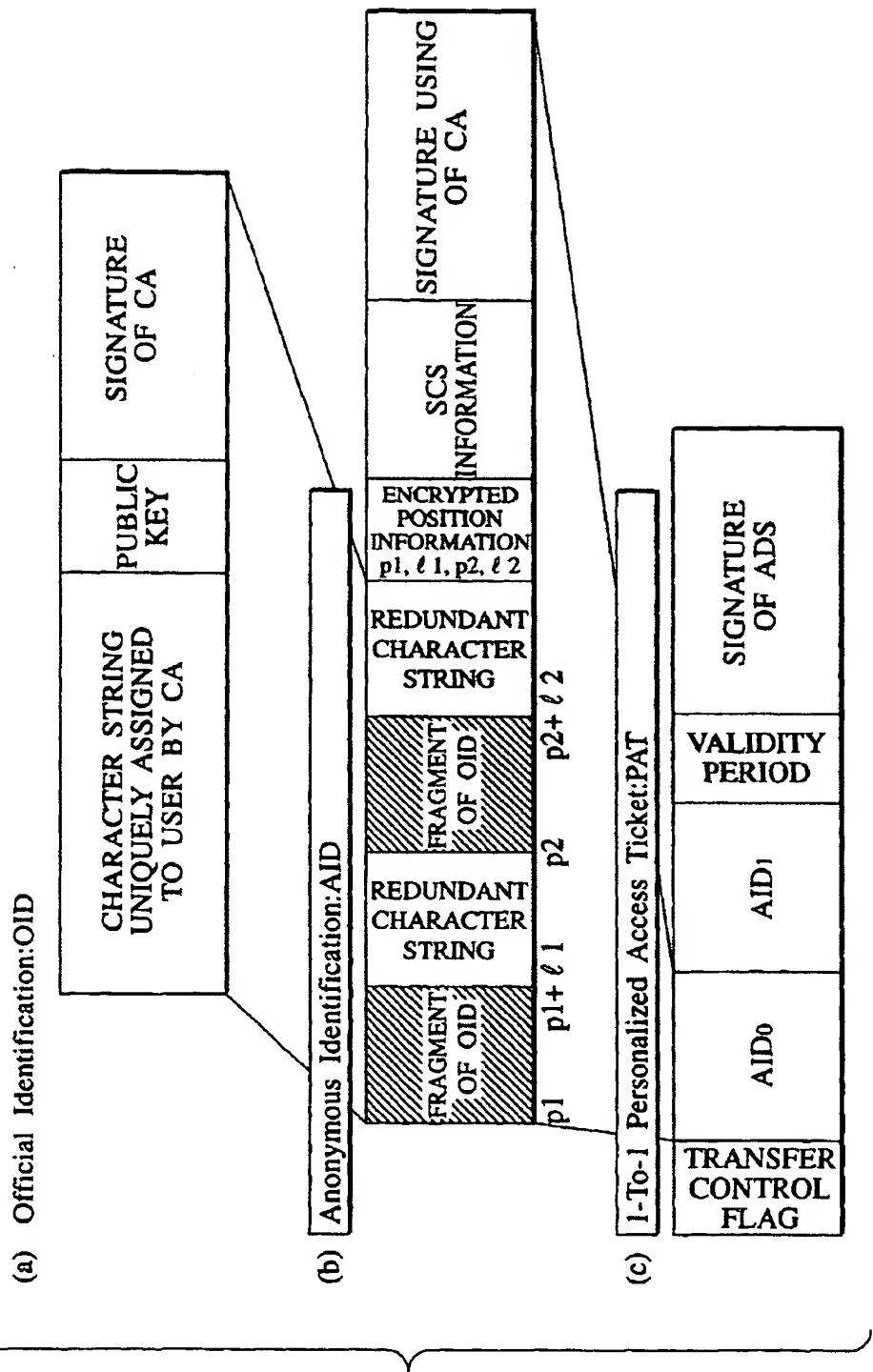


FIG.3

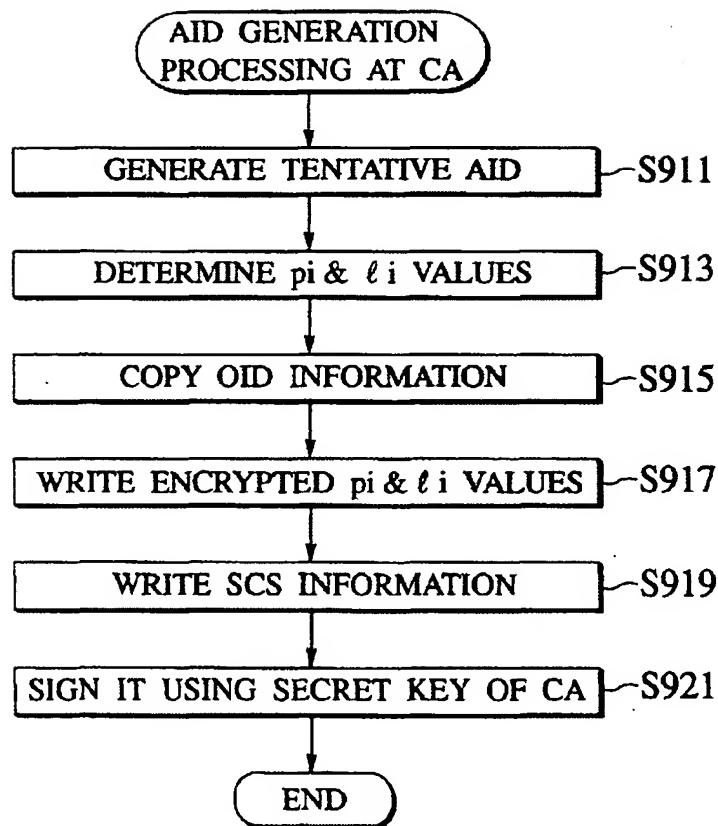


FIG.4

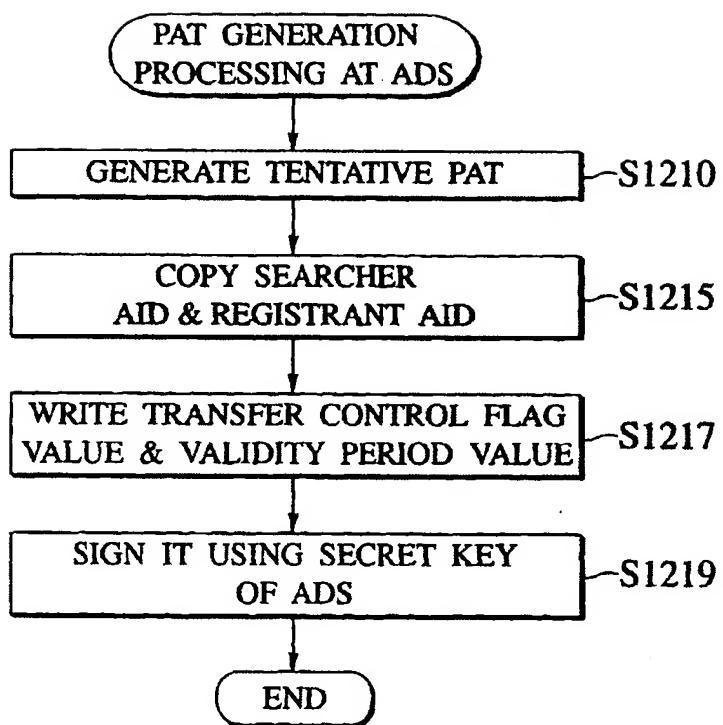


FIG.5

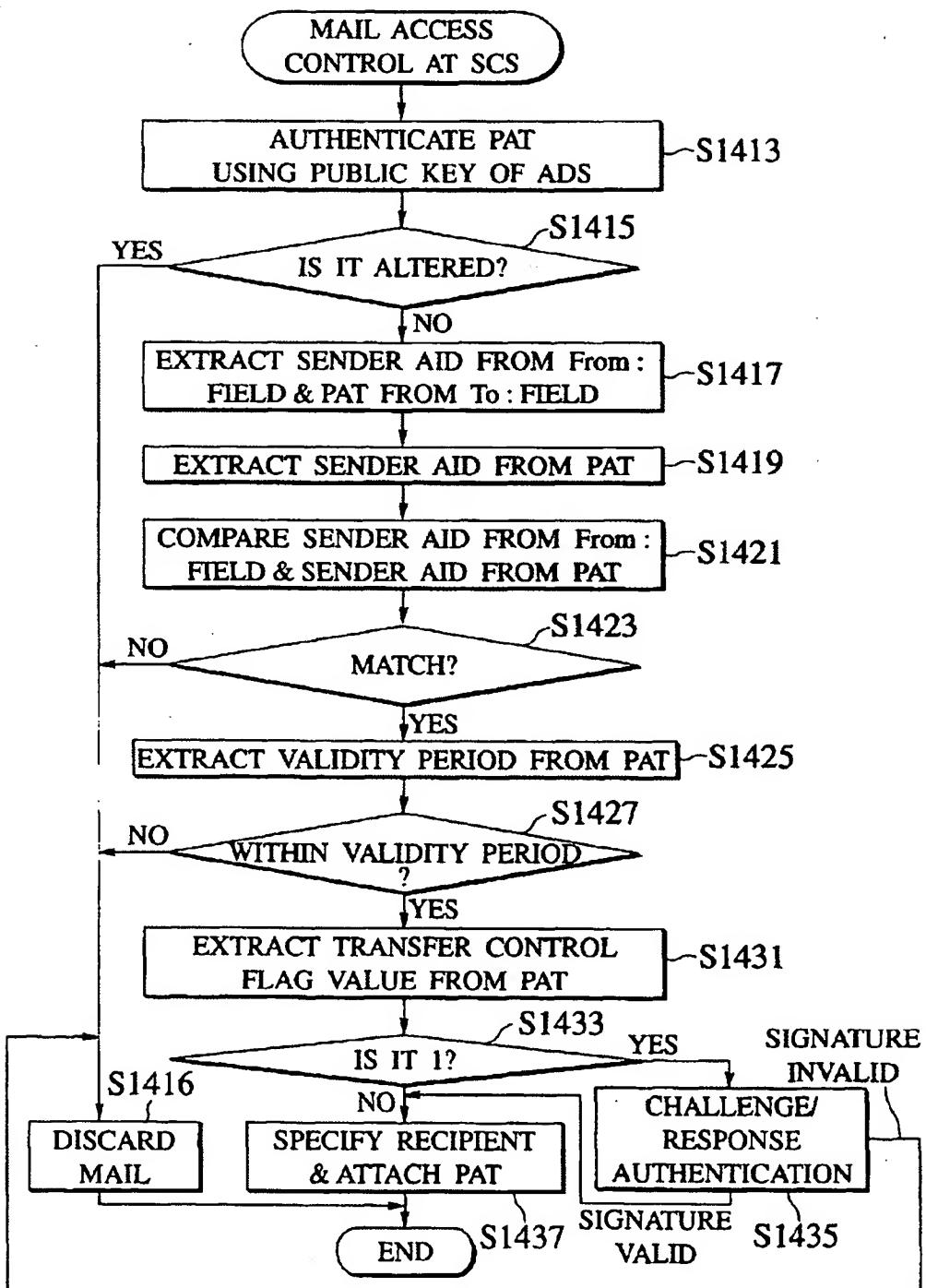


FIG.6

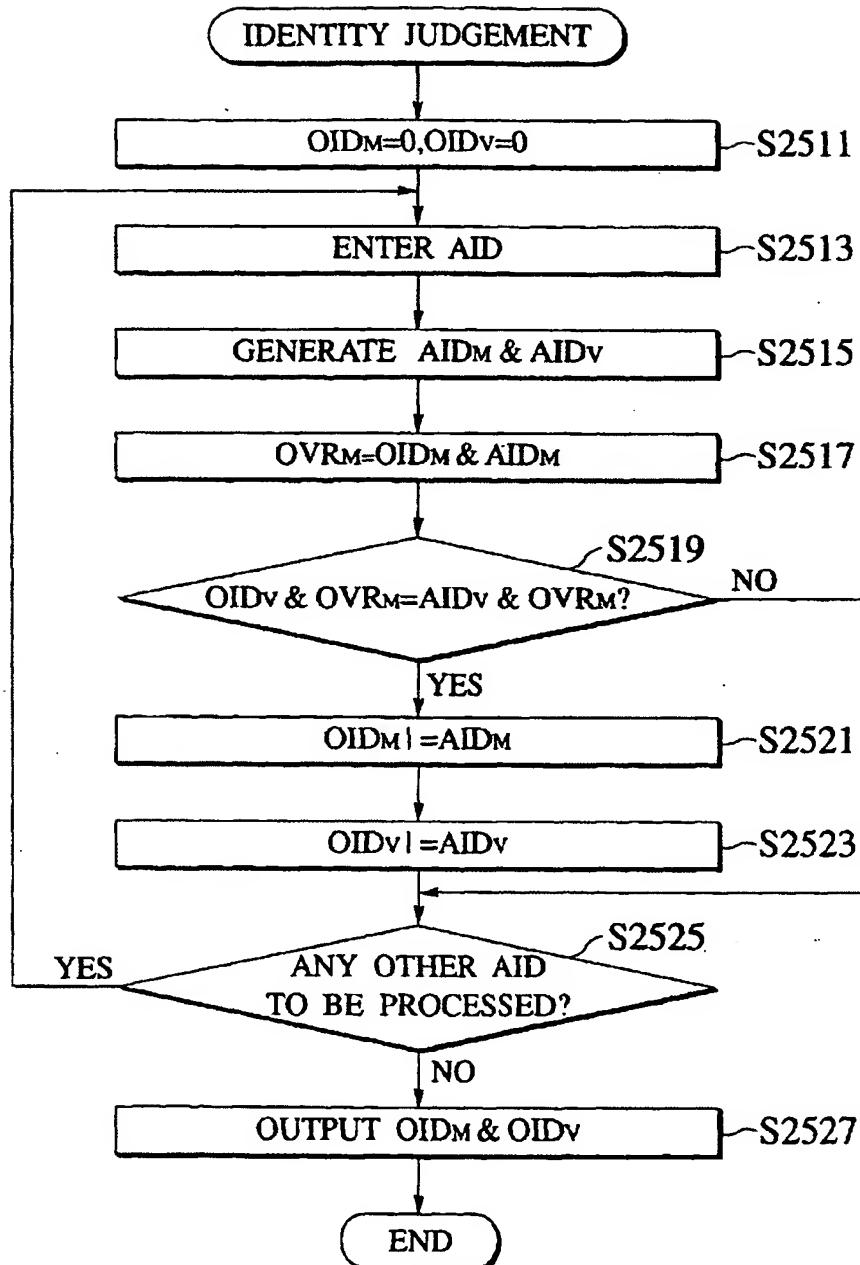


FIG.7

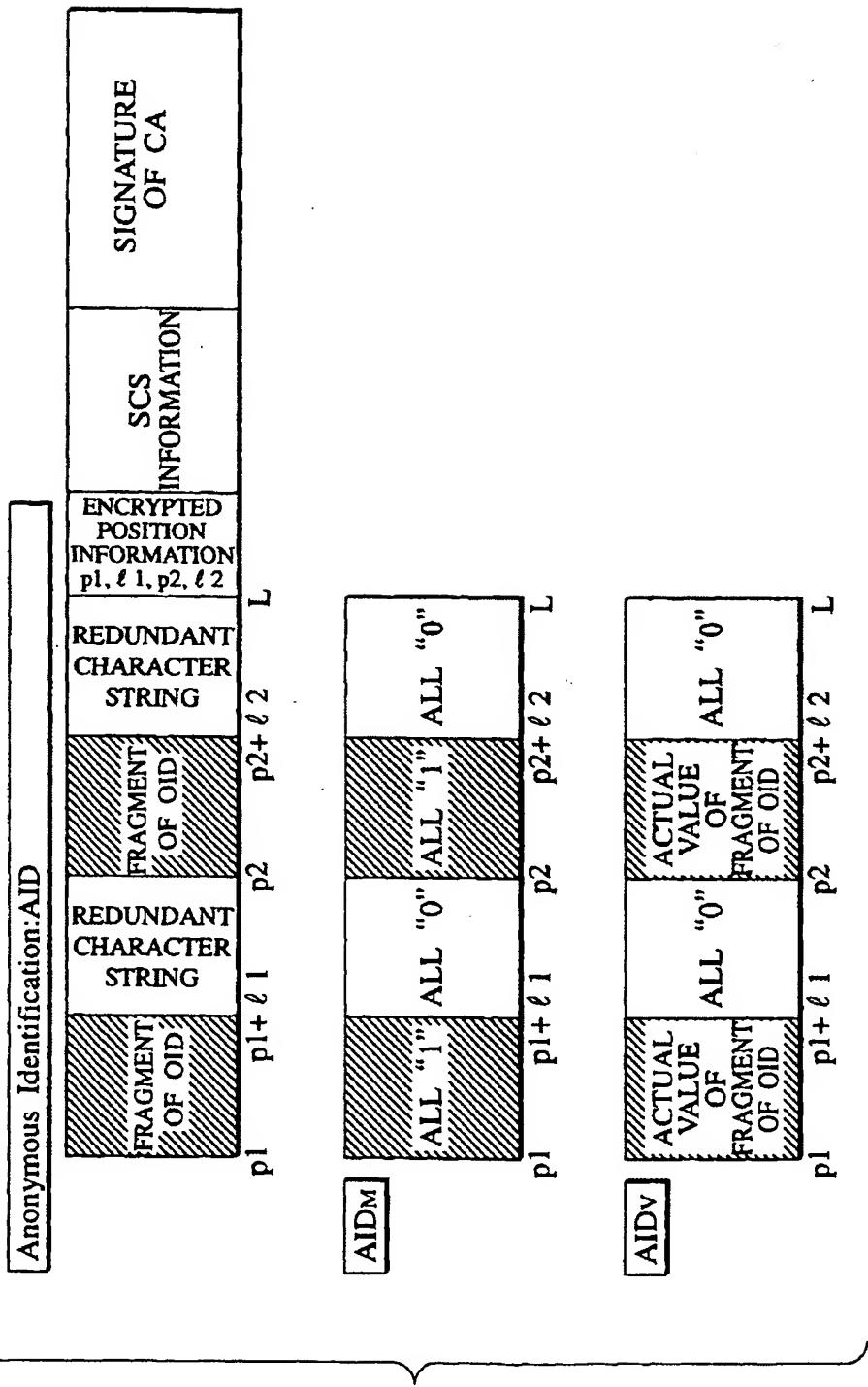


FIG. 8

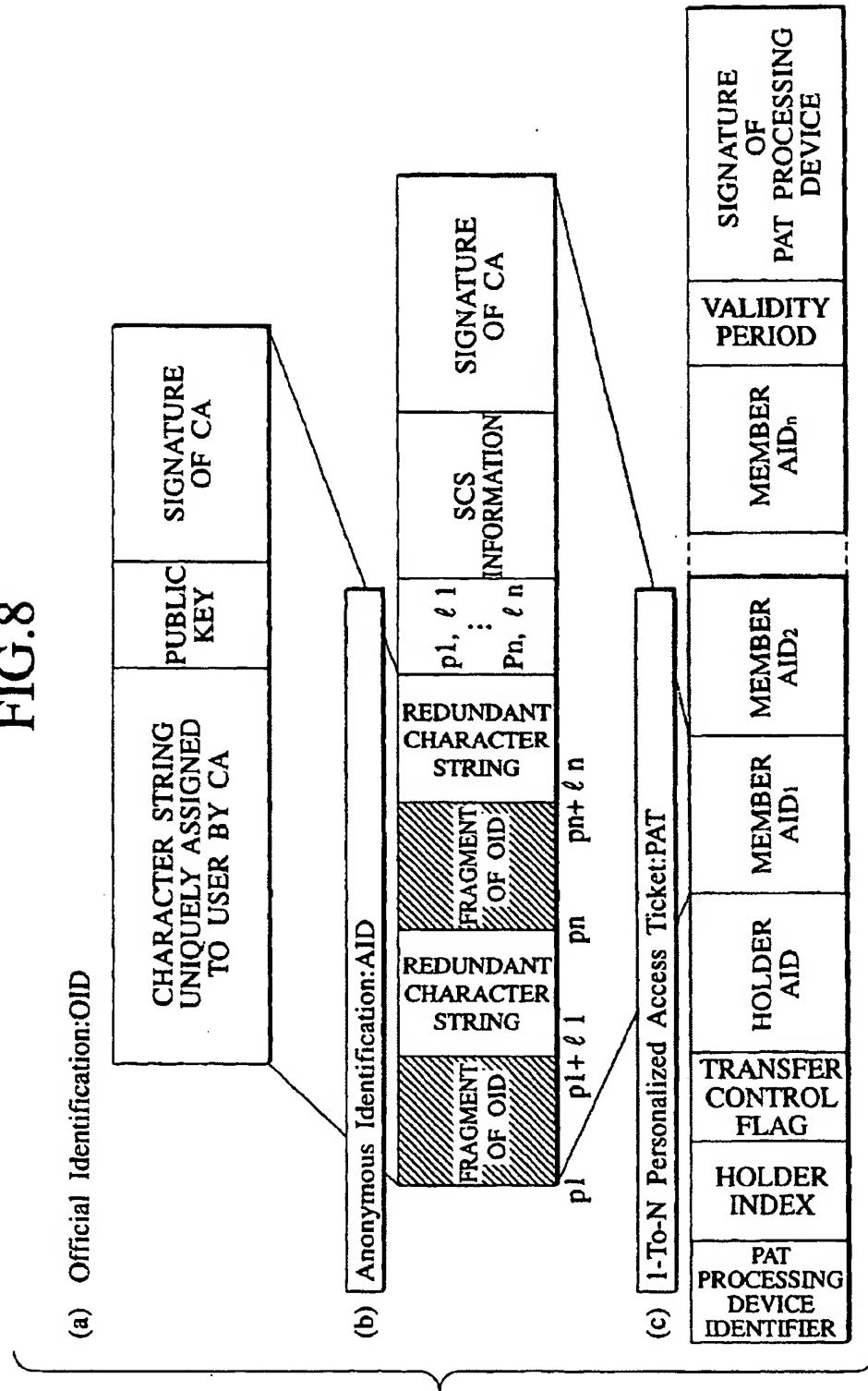


FIG.9

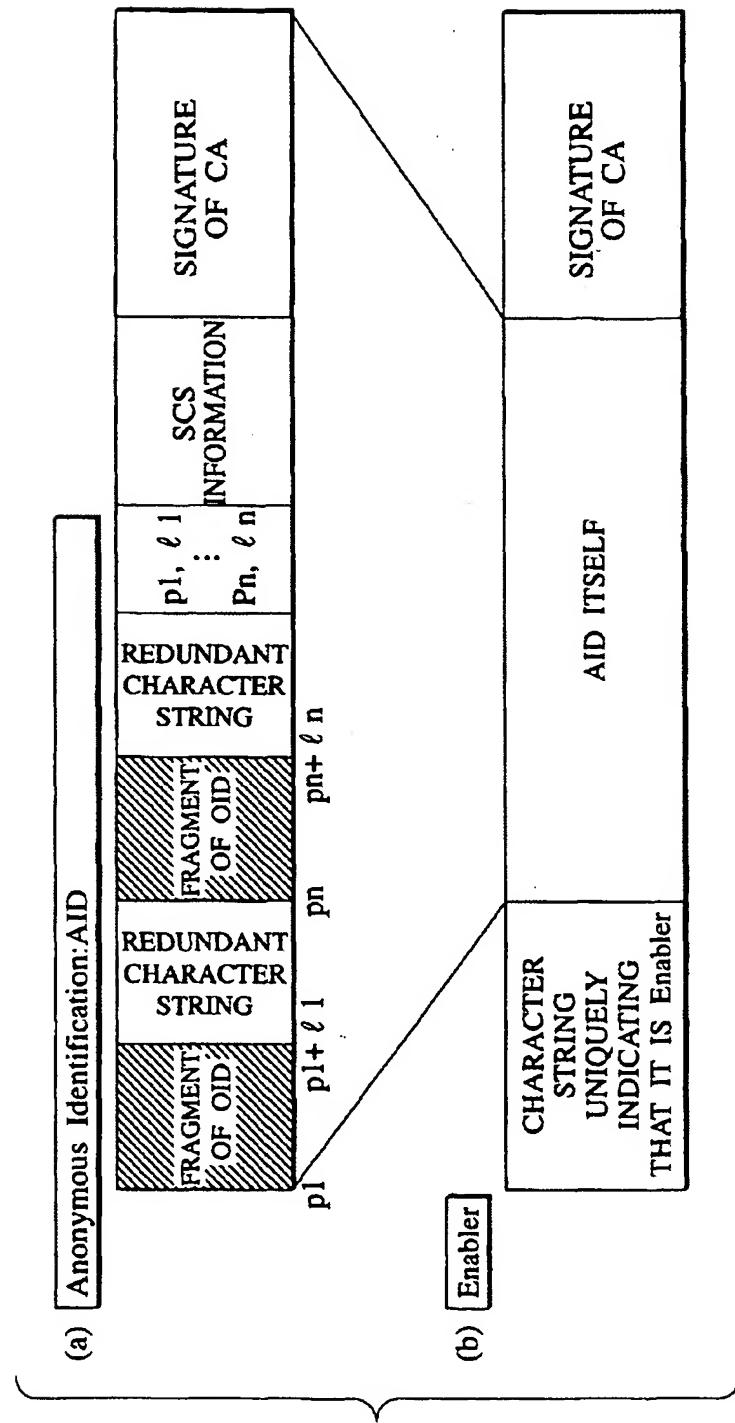


FIG.10

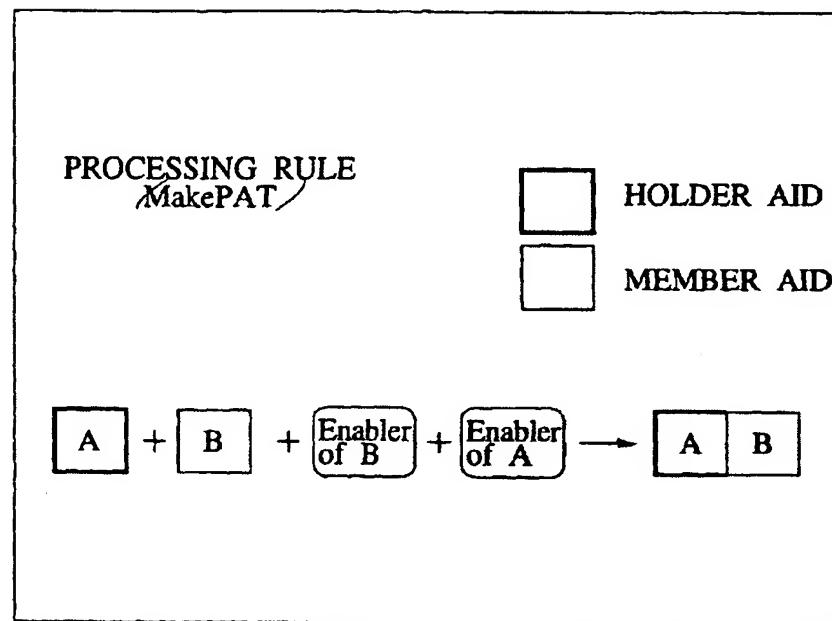


FIG.11

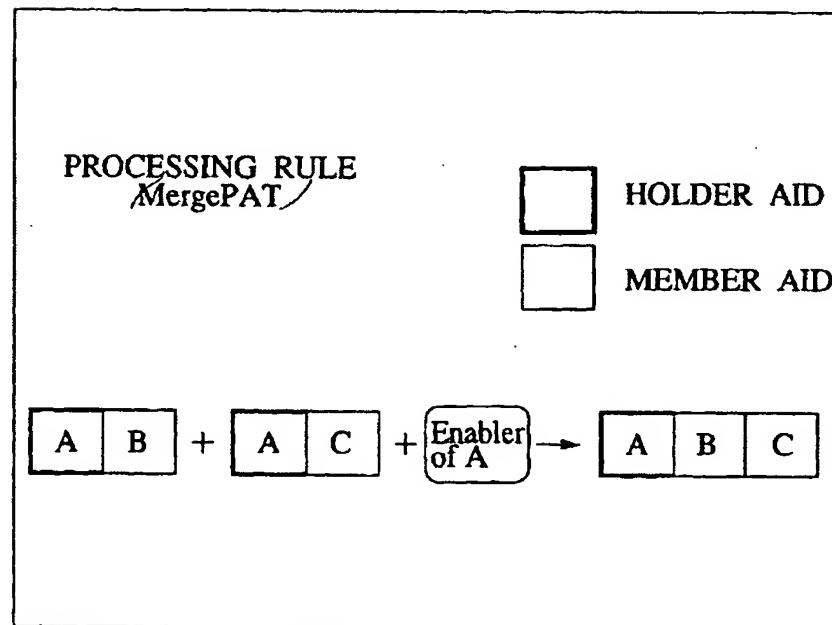


FIG.12

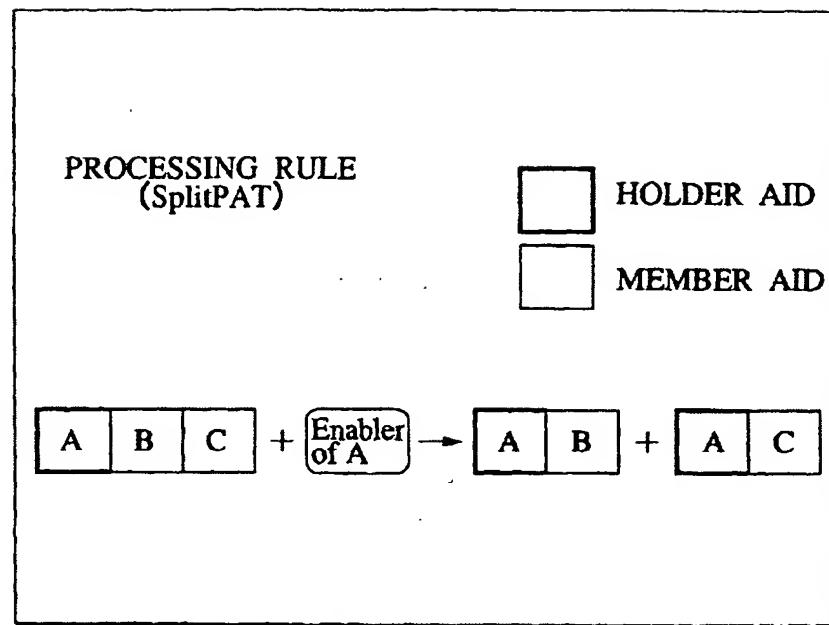


FIG.13

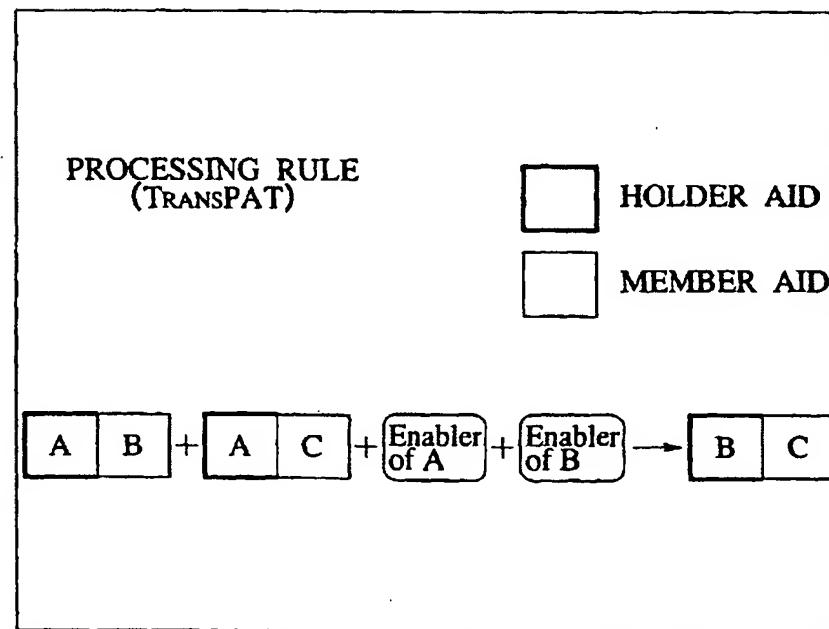


FIG.14

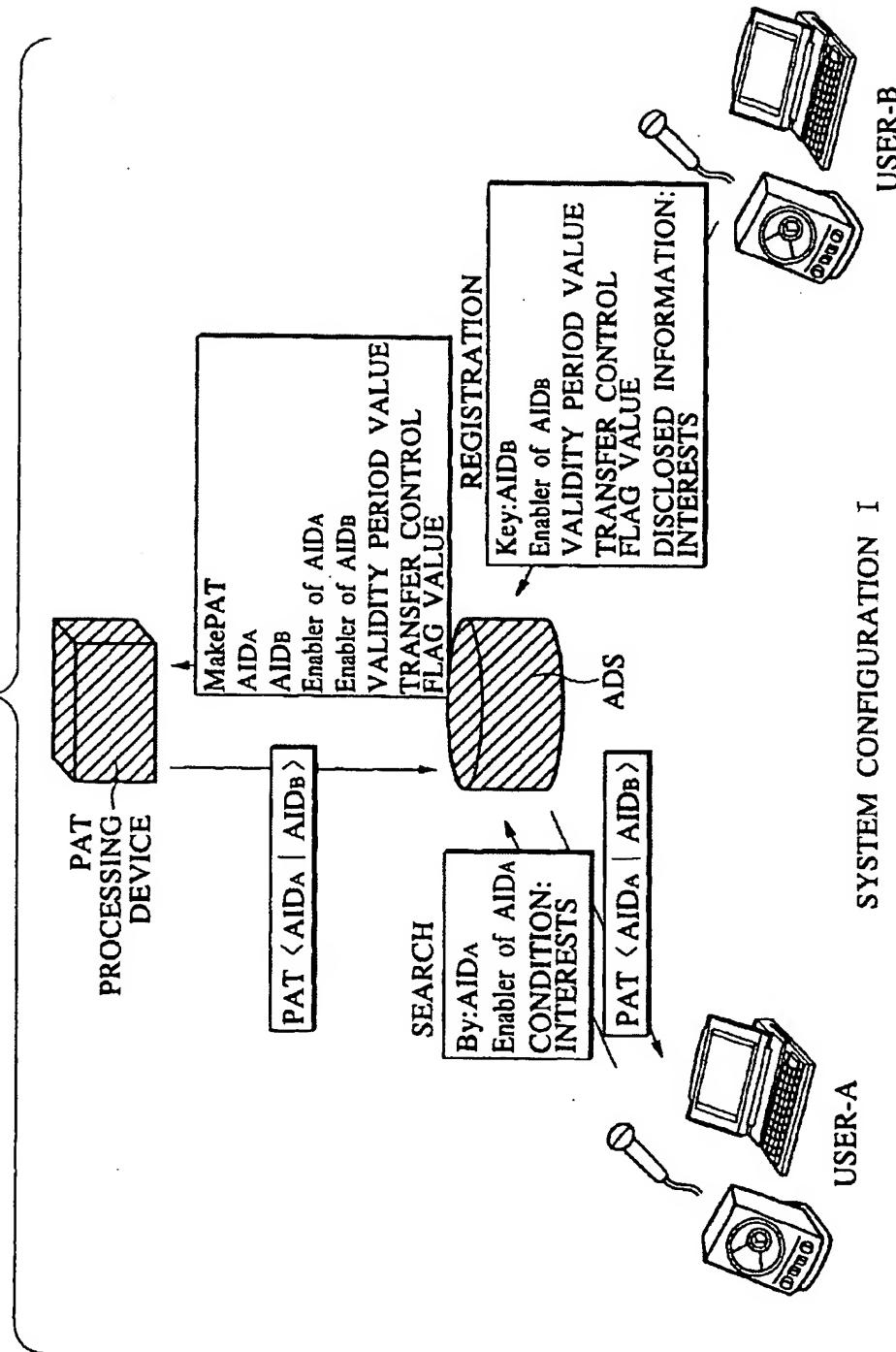


FIG.15

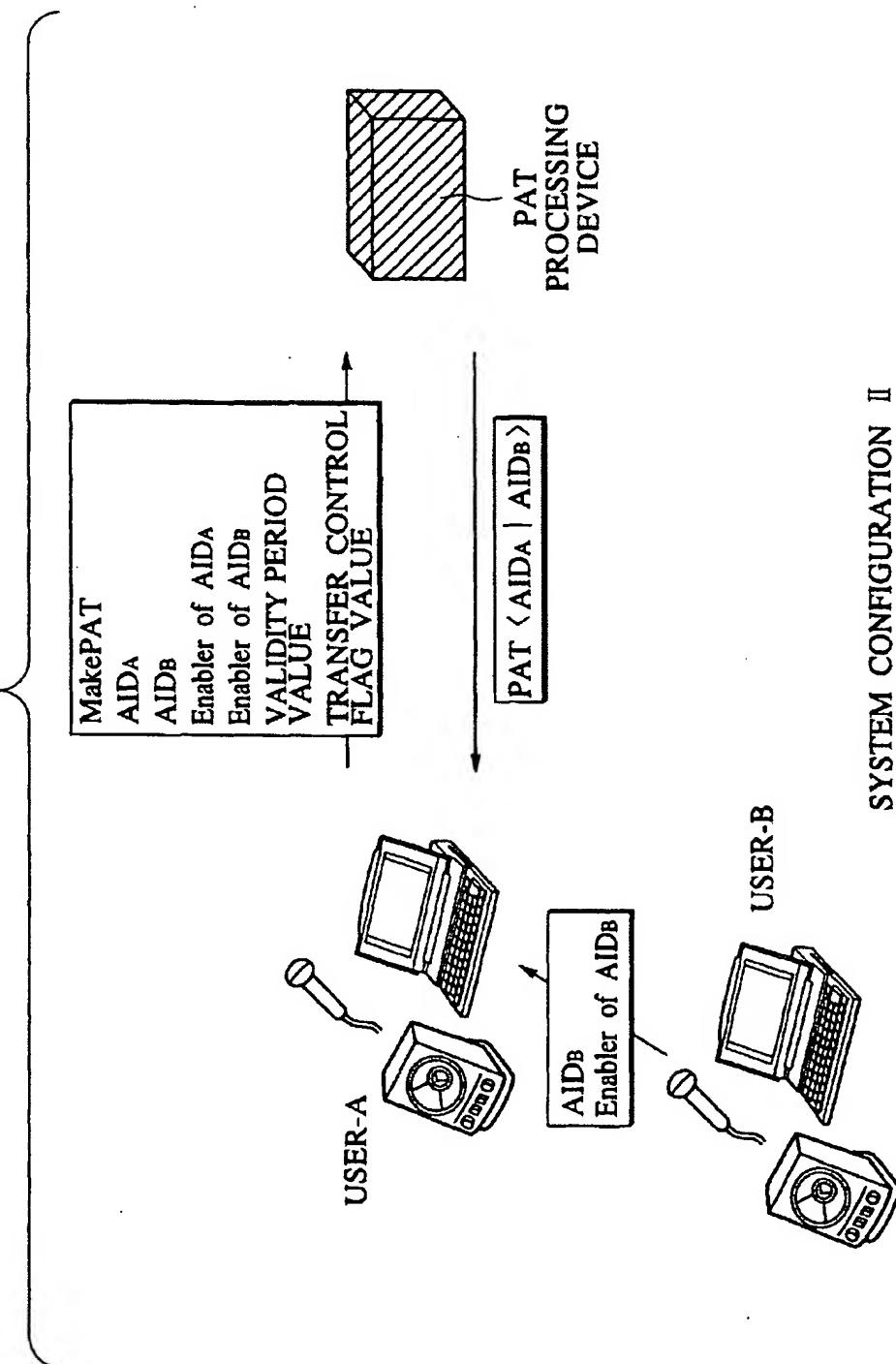


FIG.16

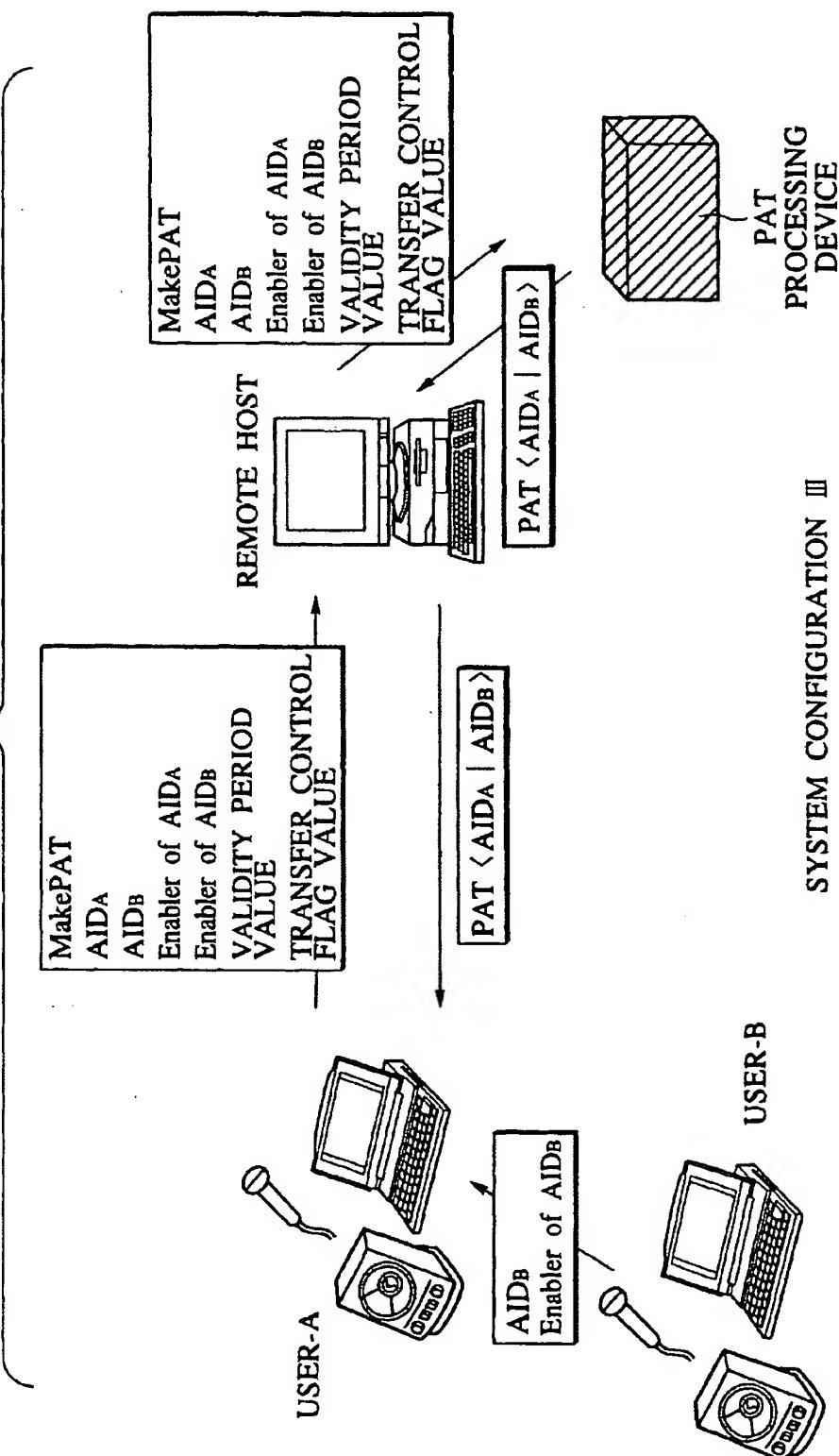


FIG.17

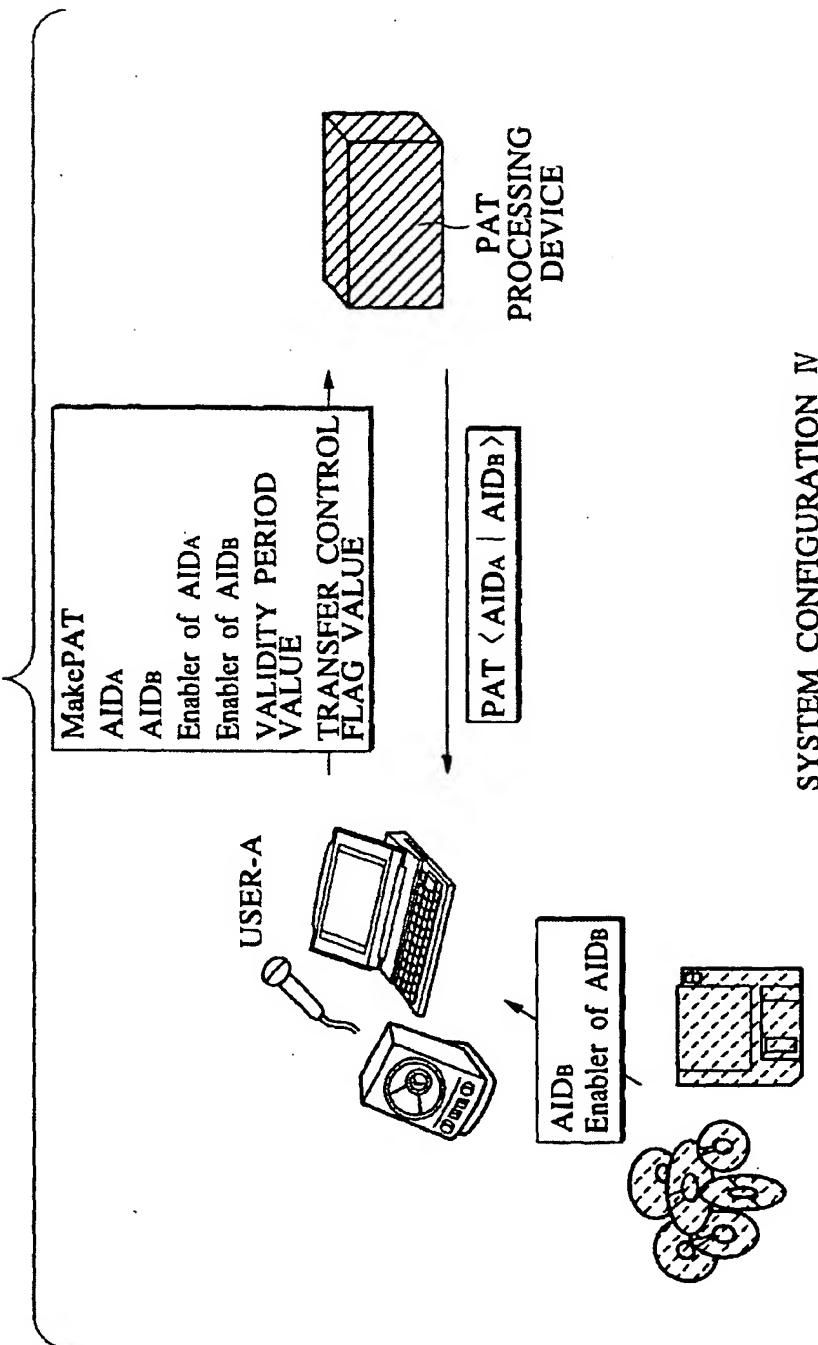


FIG.18

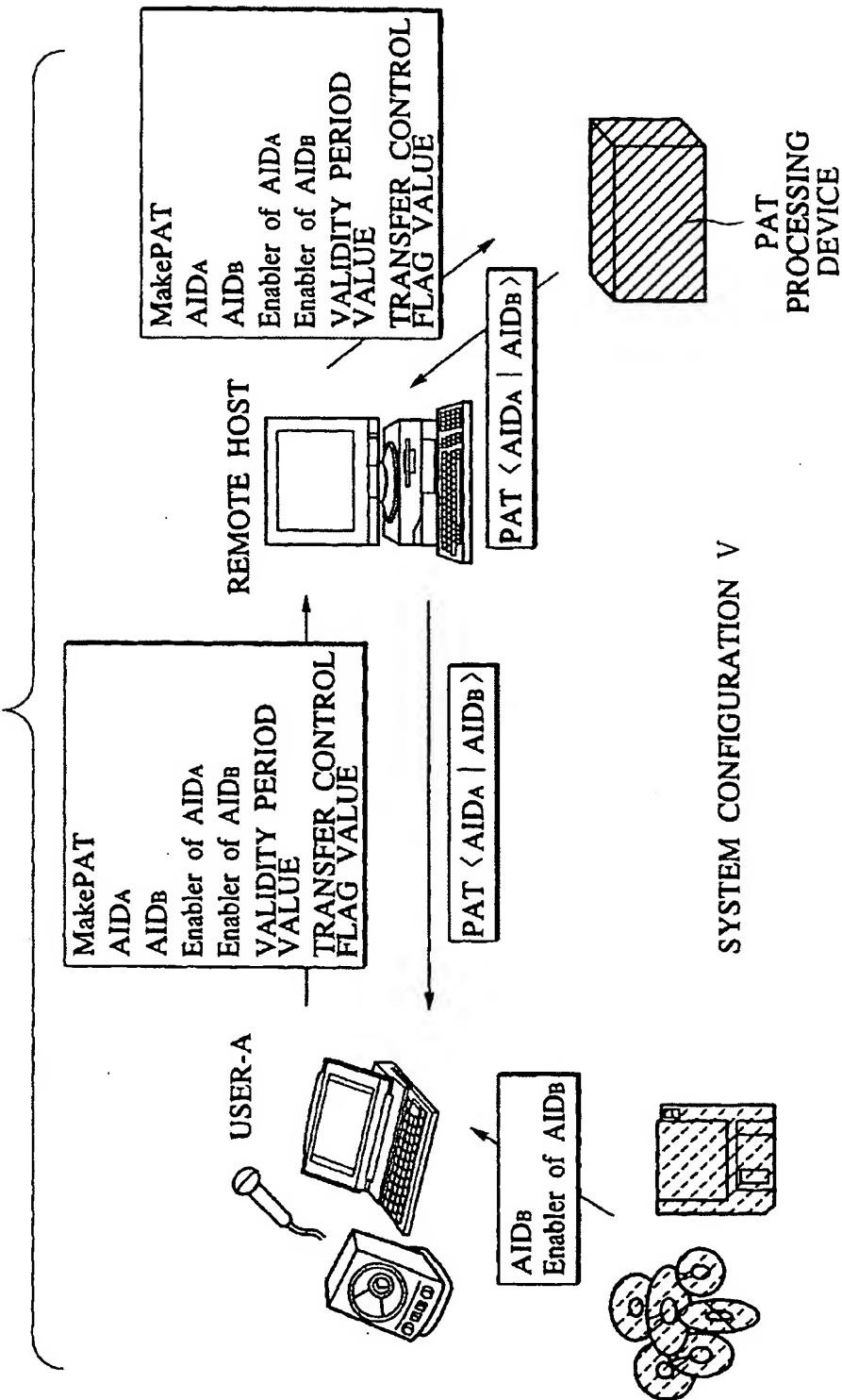


FIG.19

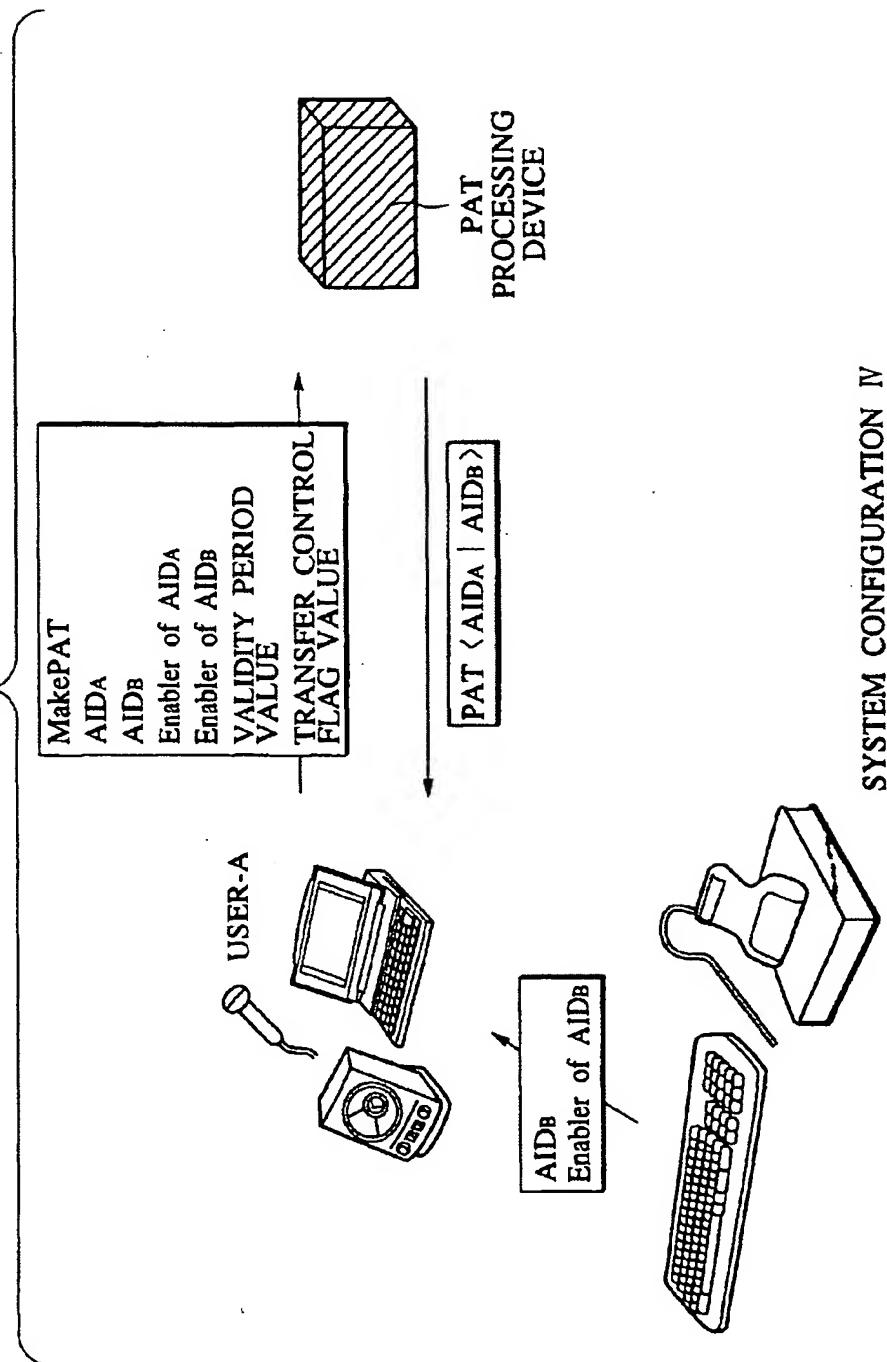


FIG.20

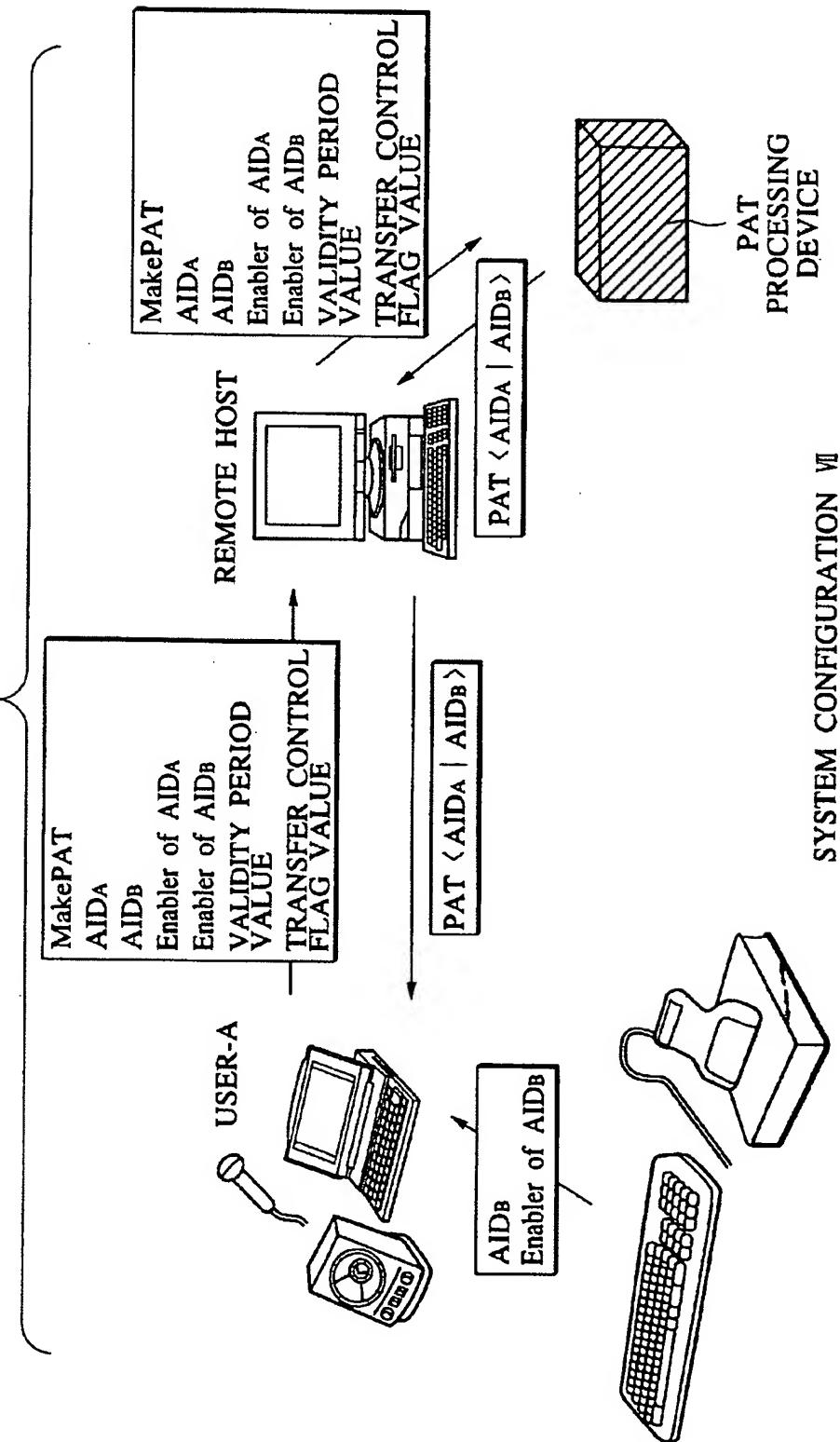


FIG.21

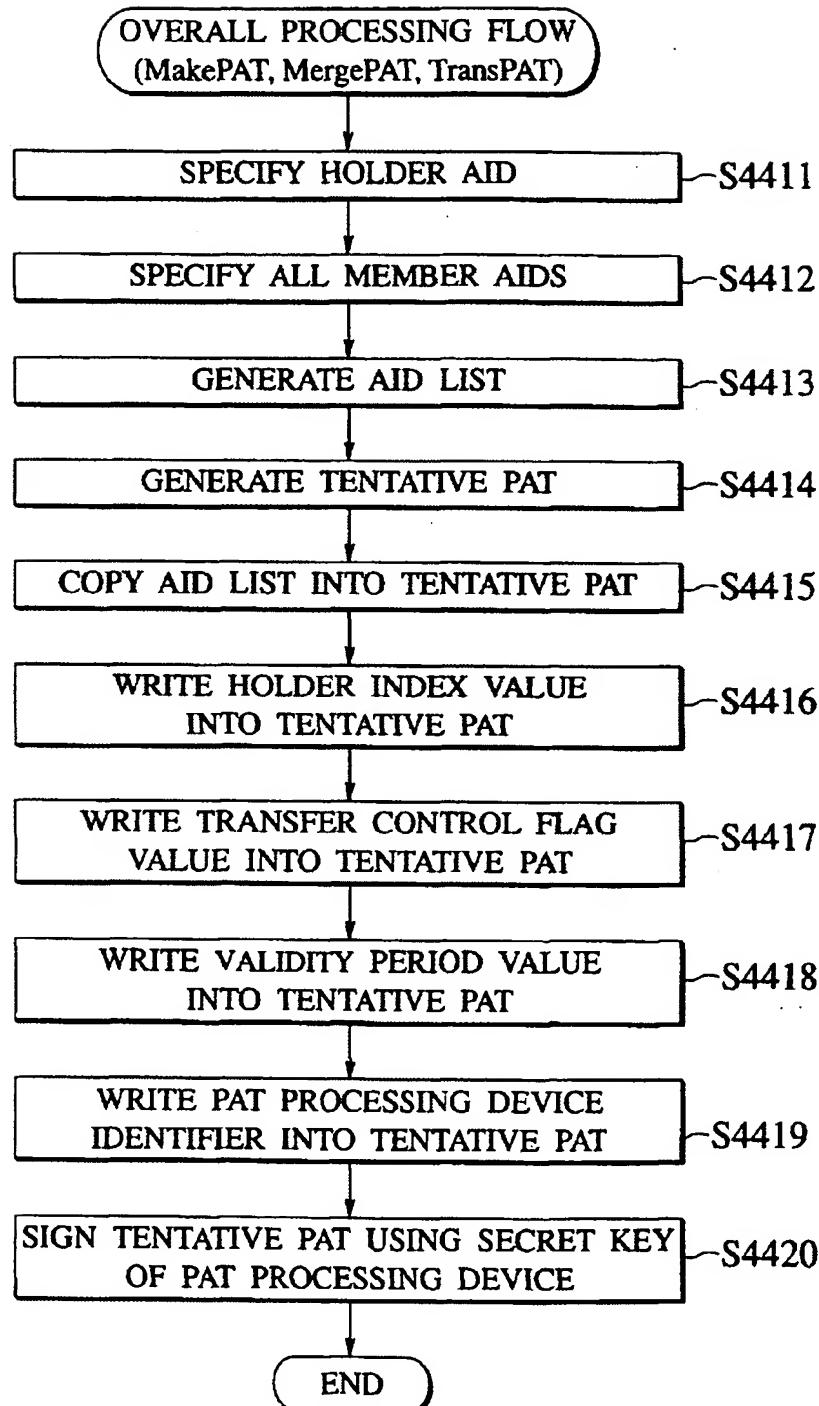


FIG.22

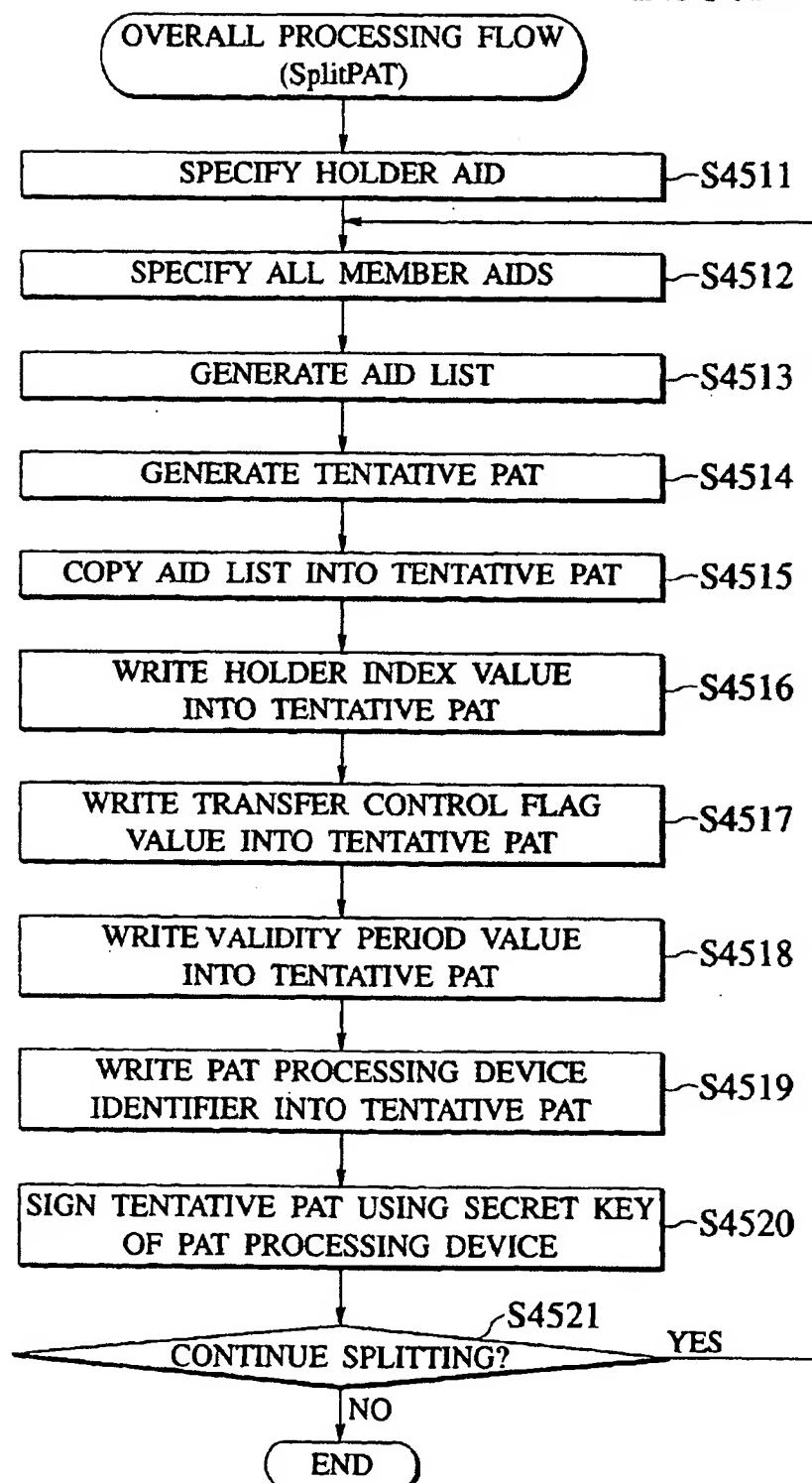


FIG.23

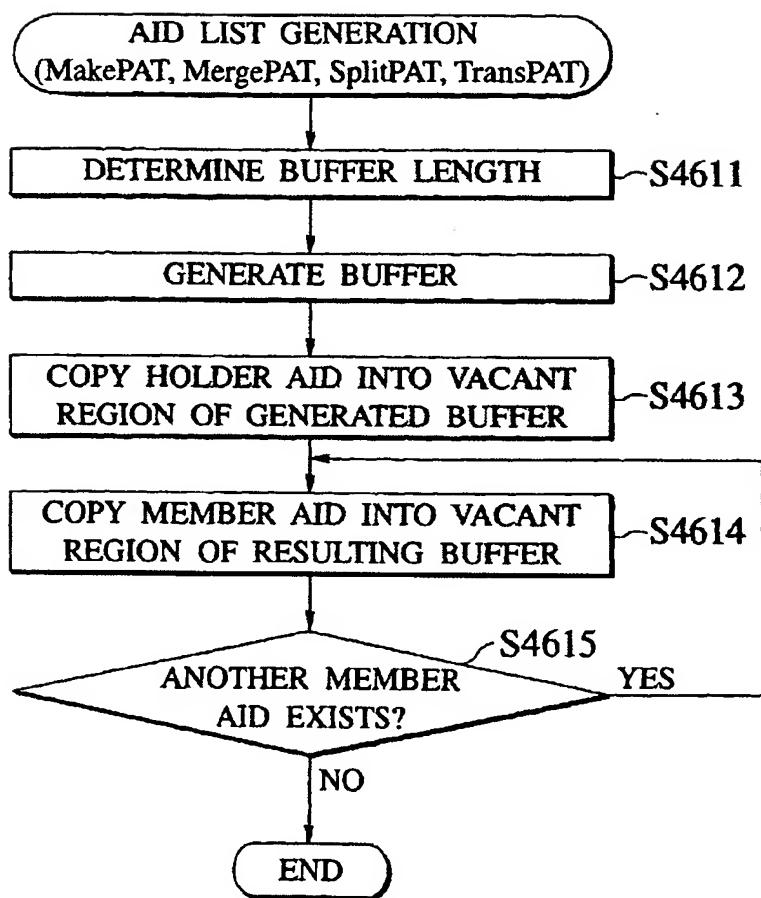


FIG.24

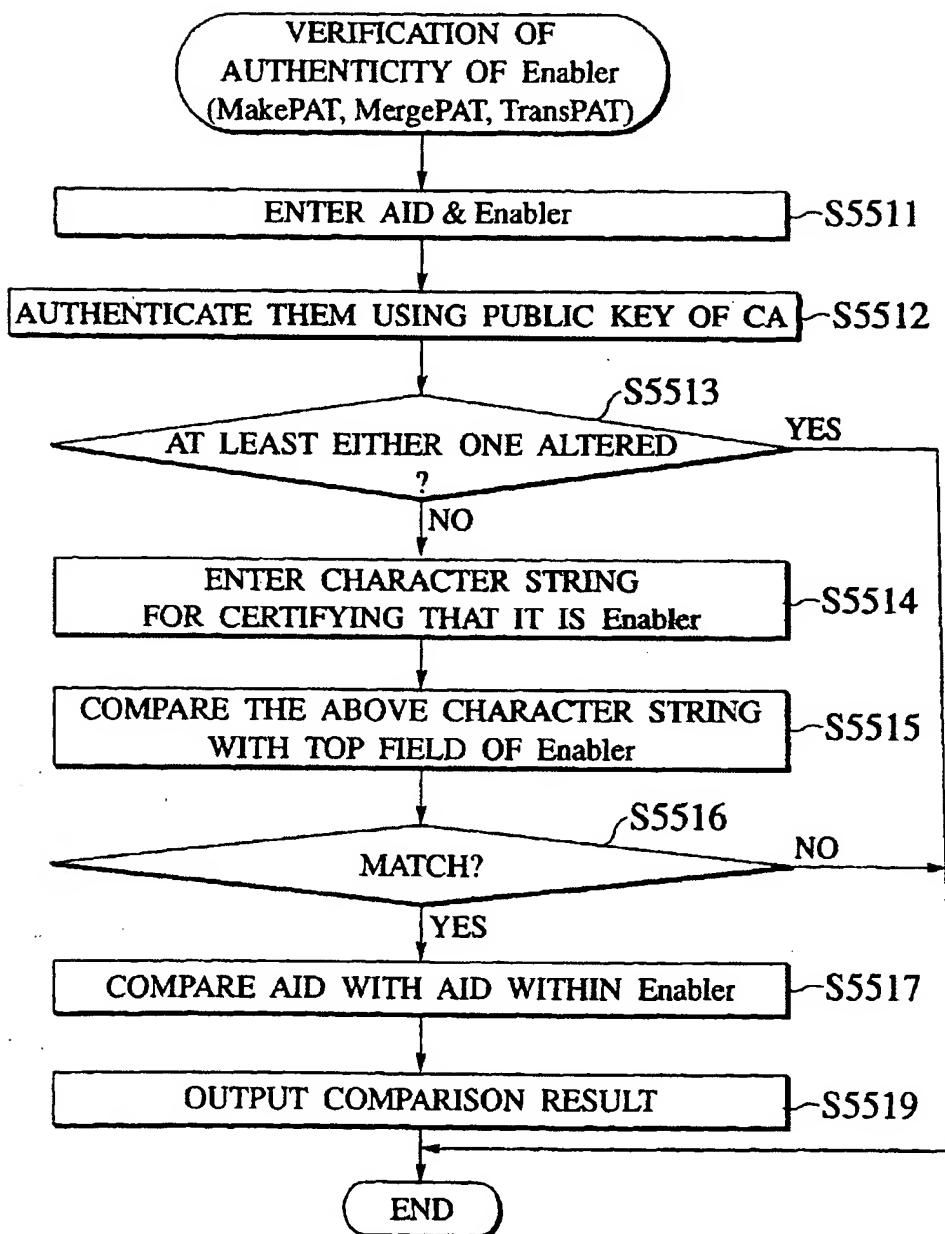


FIG.25

DATA STRUCTURE OF Null-AID

CHARACTER STRING UNIQUELY INDICATING THAT IT IS Null-AID	SIGNATURE OF CA
--	-----------------

FIG.26

DATA STRUCTURE OF Enabler of Null-AID

CHARACTER STRING UNIQUELY INDICATING THAT IT IS Enabler	Null-AID ITSELF	SIGNATURE OF CA
---	-----------------	-----------------

FIG.27

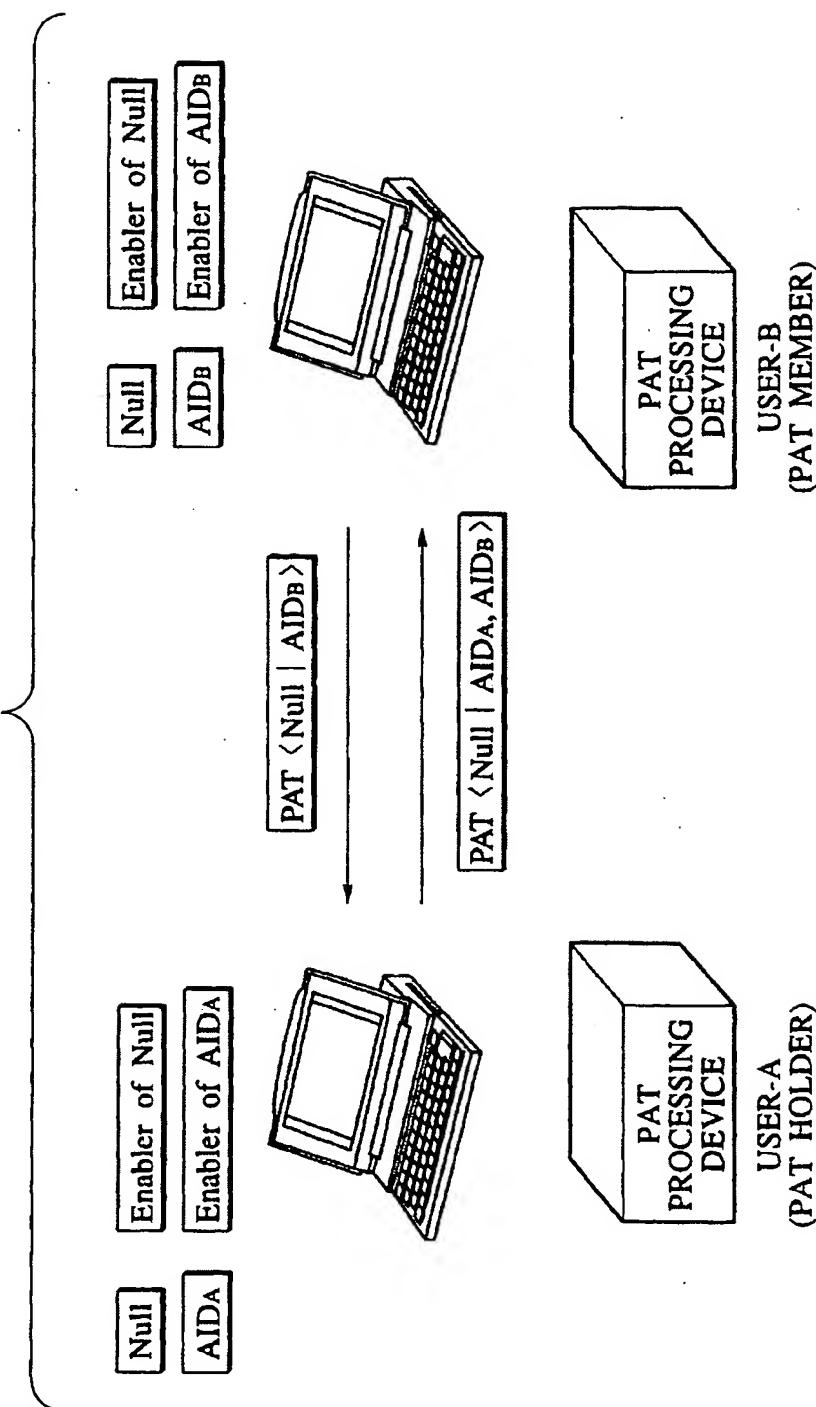


FIG.28

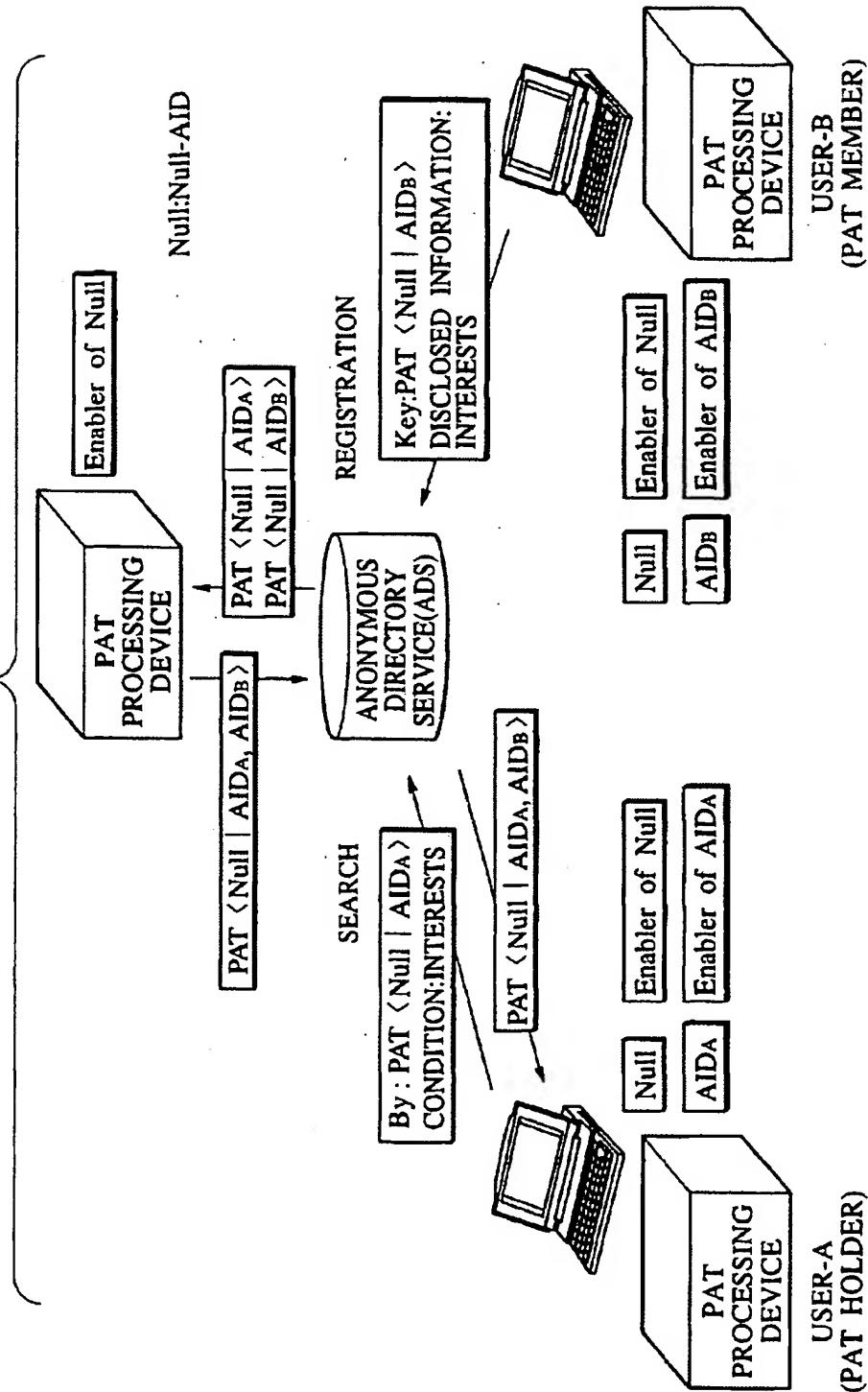


FIG.29

DATA STRUCTURE OF God-AID



FIG.30

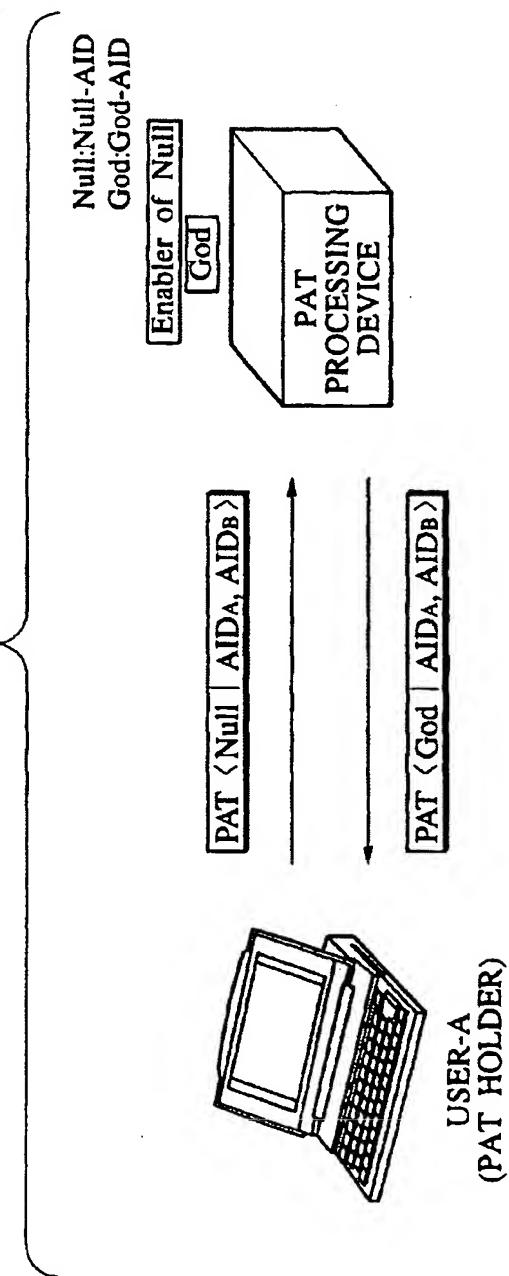


FIG.31

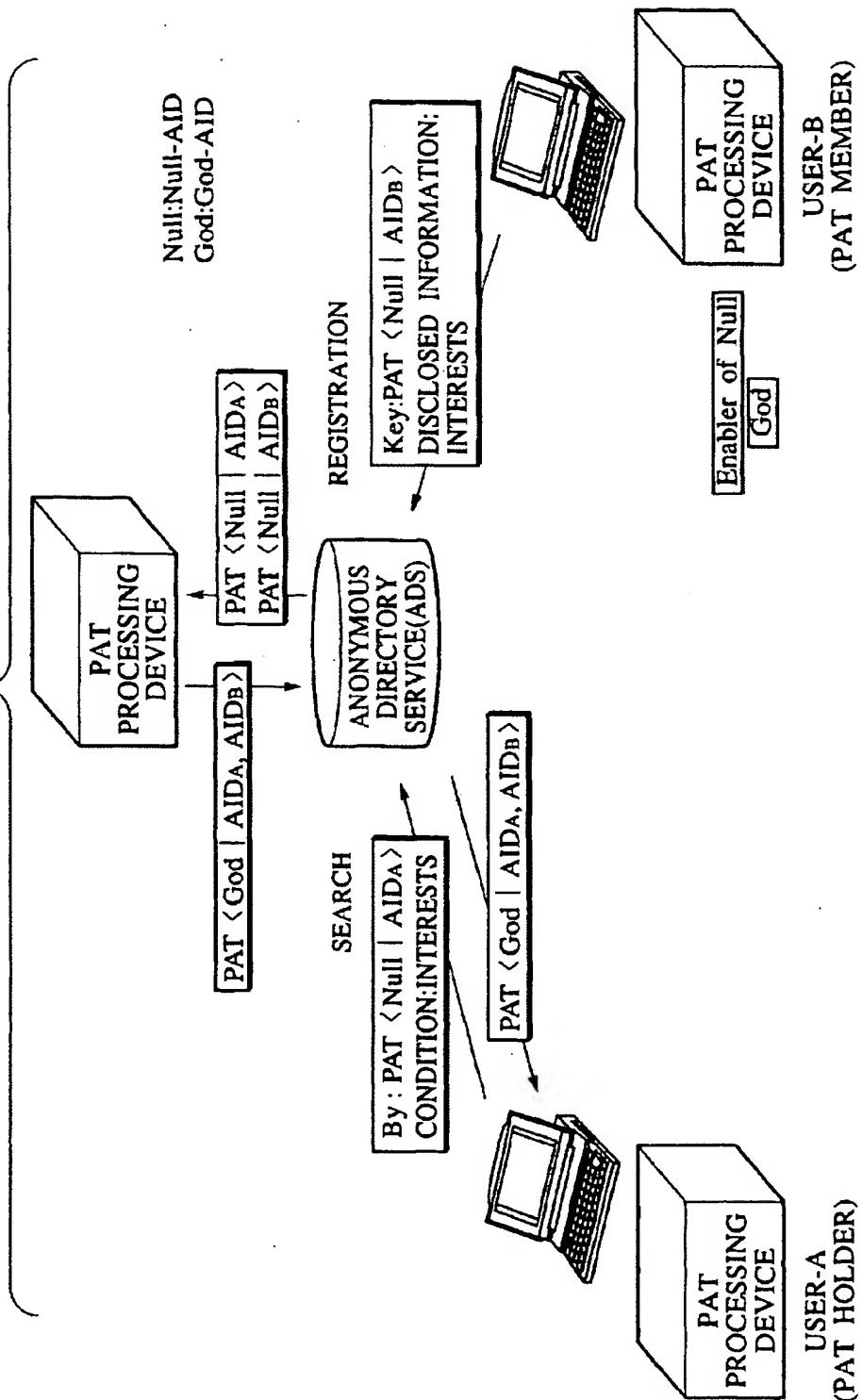


FIG.32

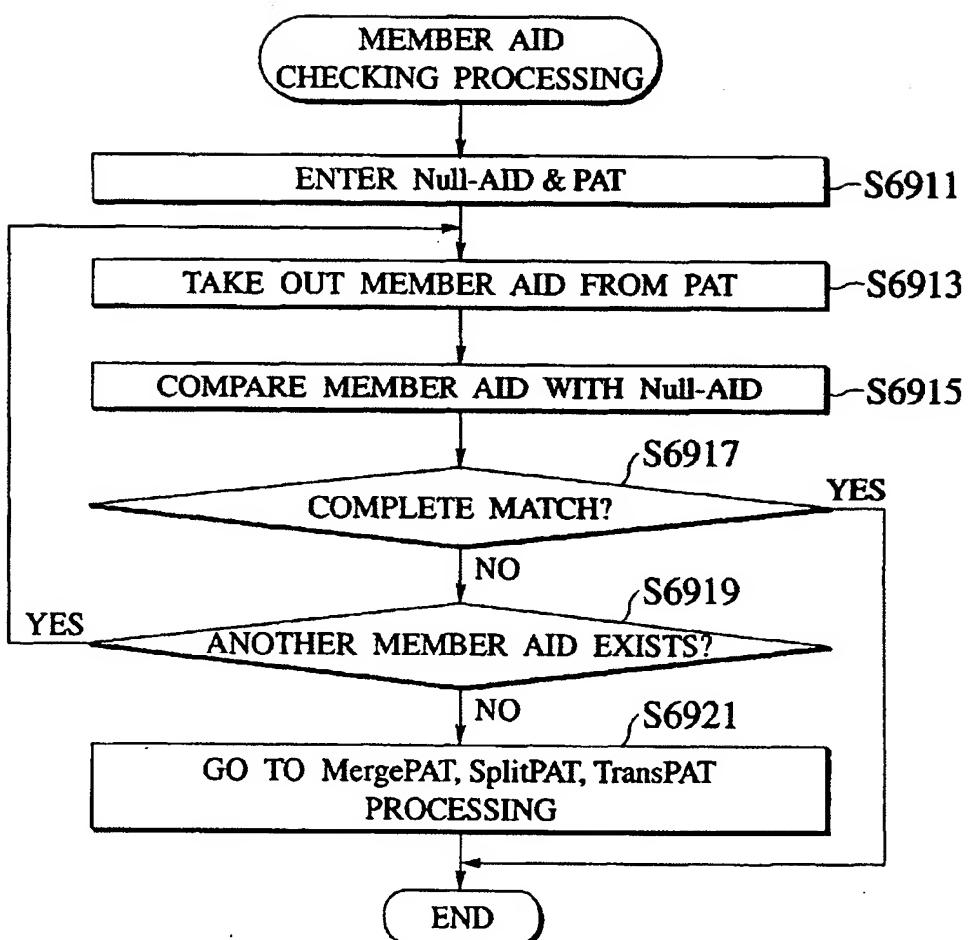


FIG.33

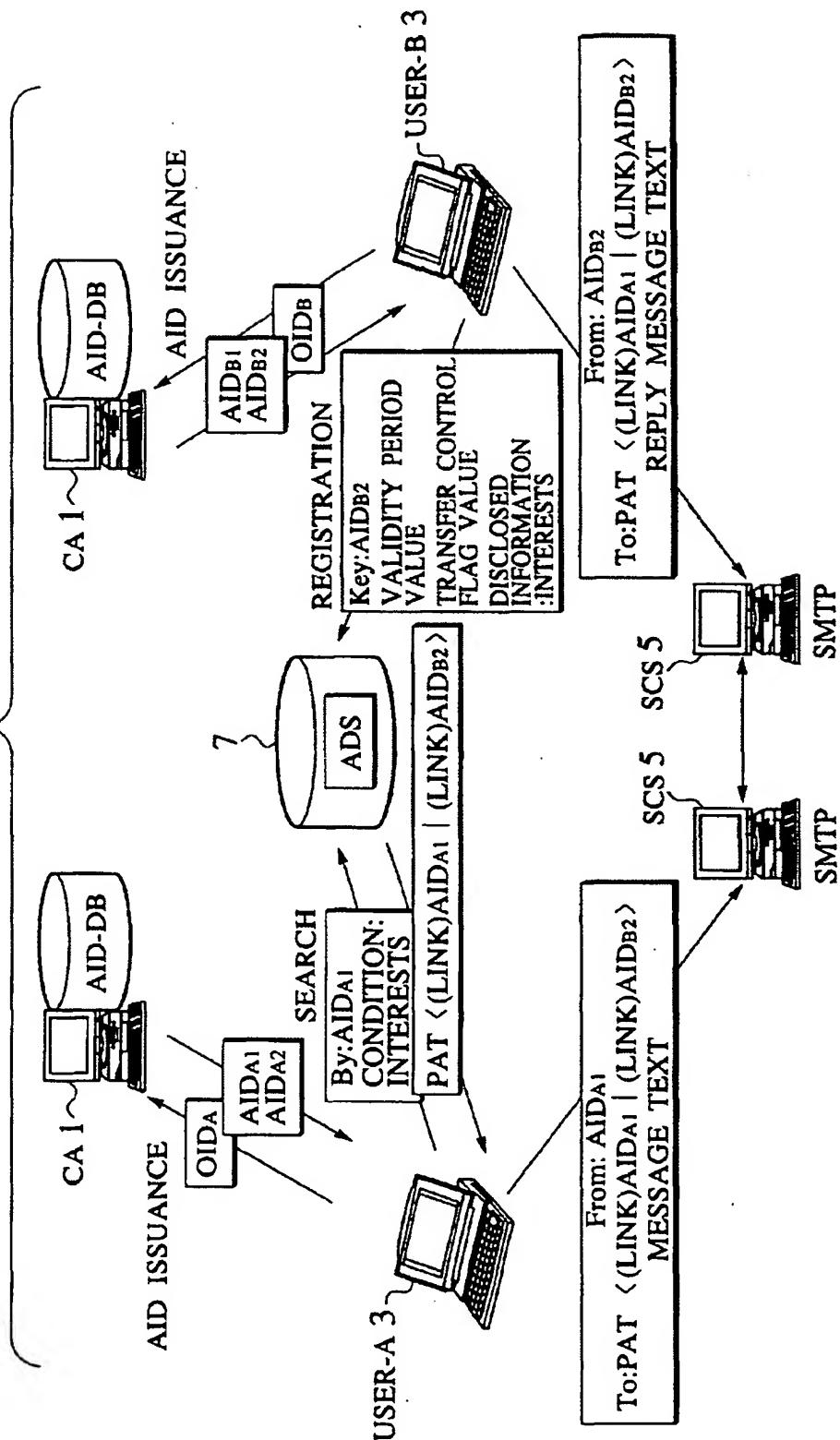


FIG.34

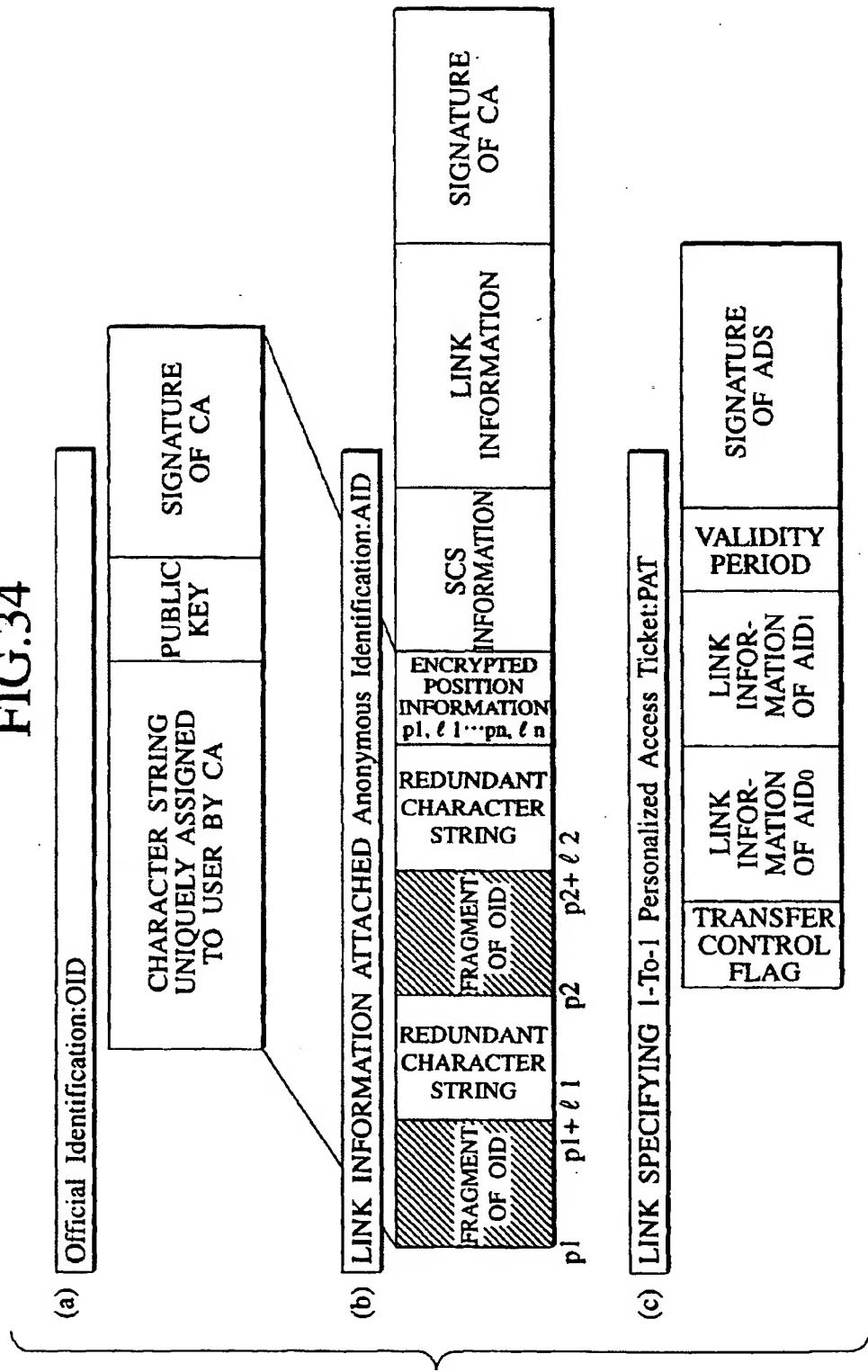


FIG.35

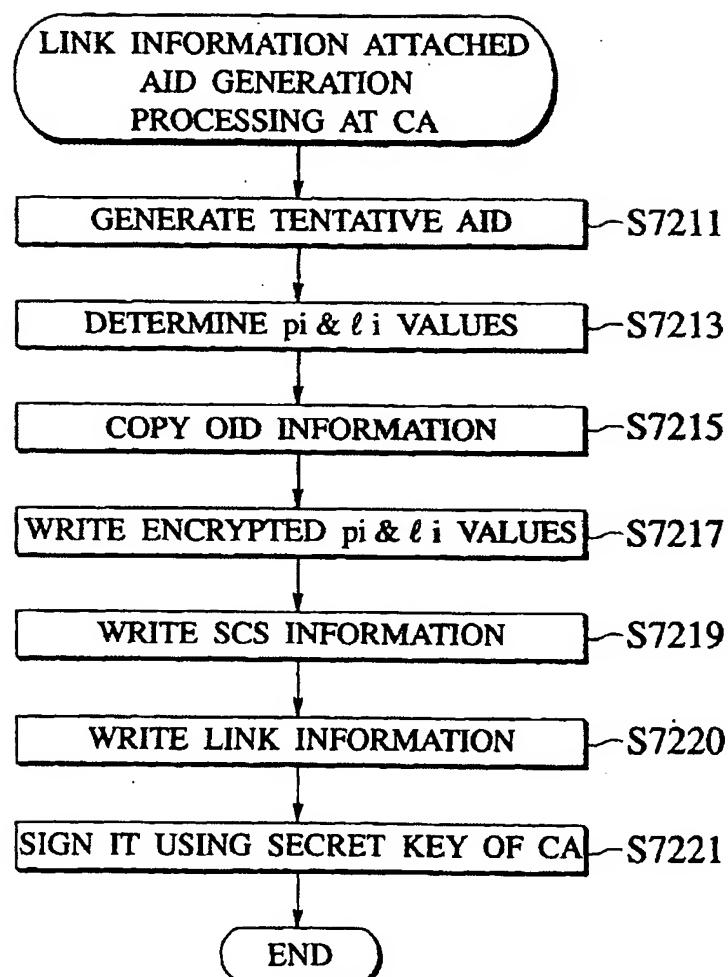


FIG.36

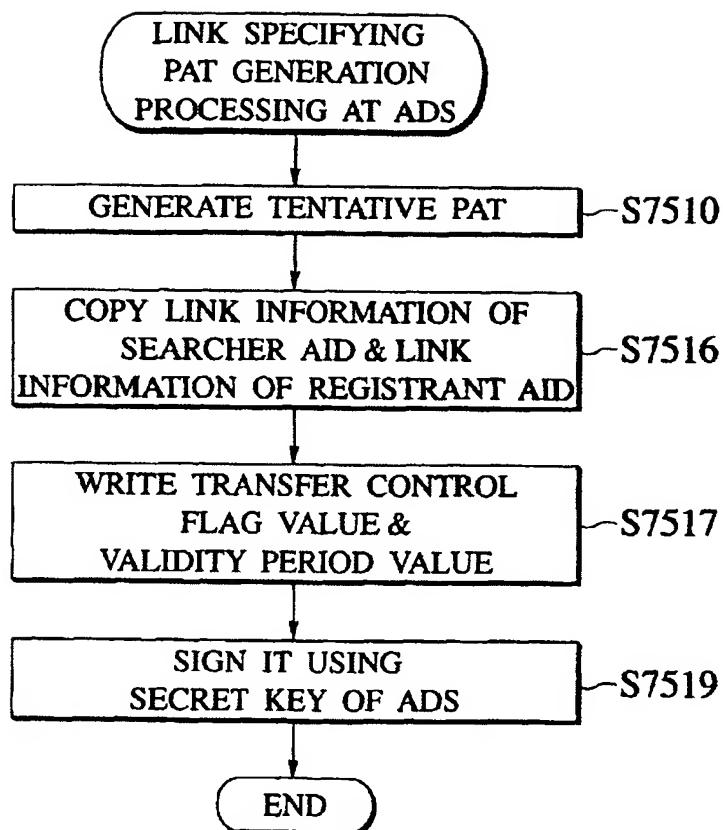


FIG.37

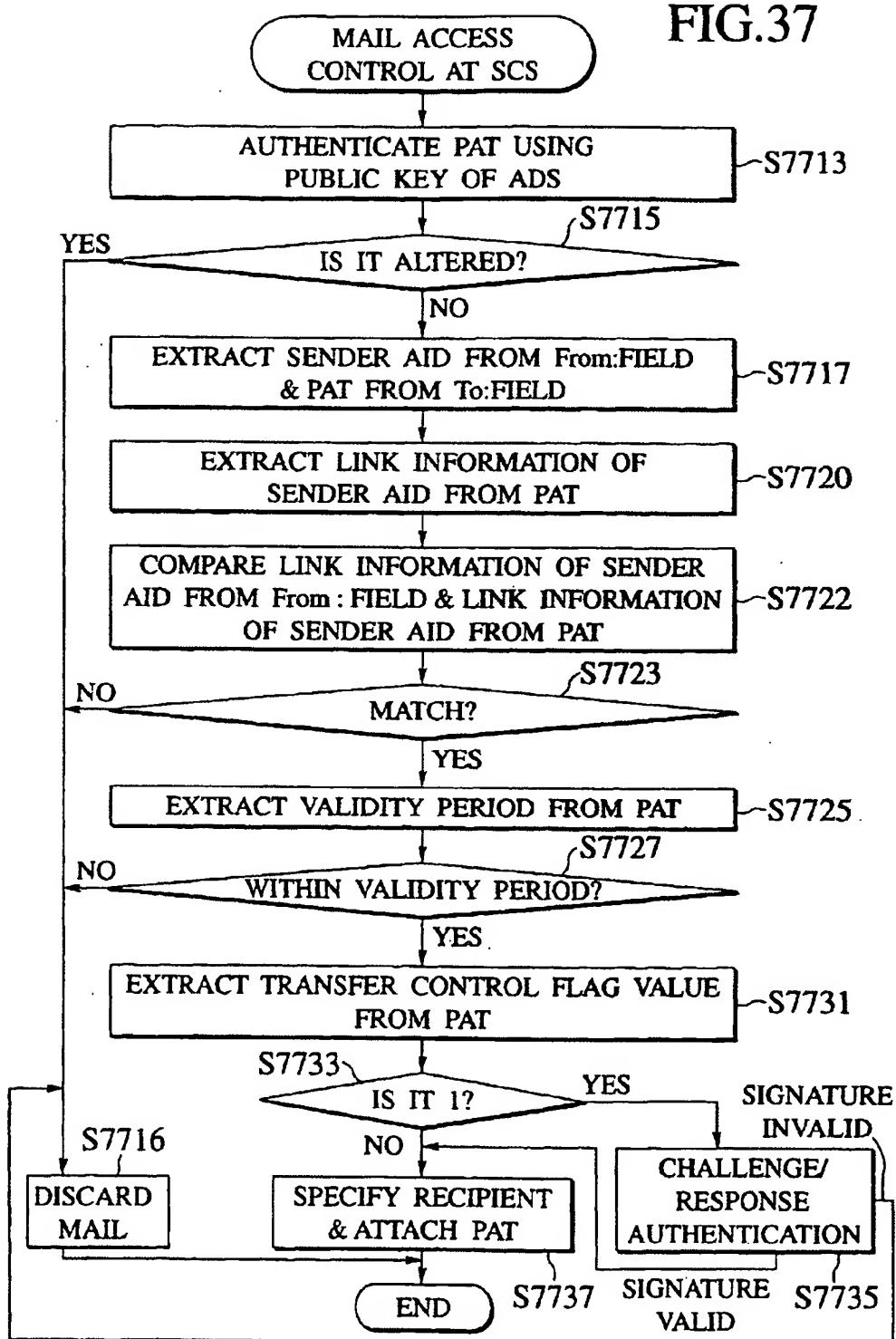


FIG.38

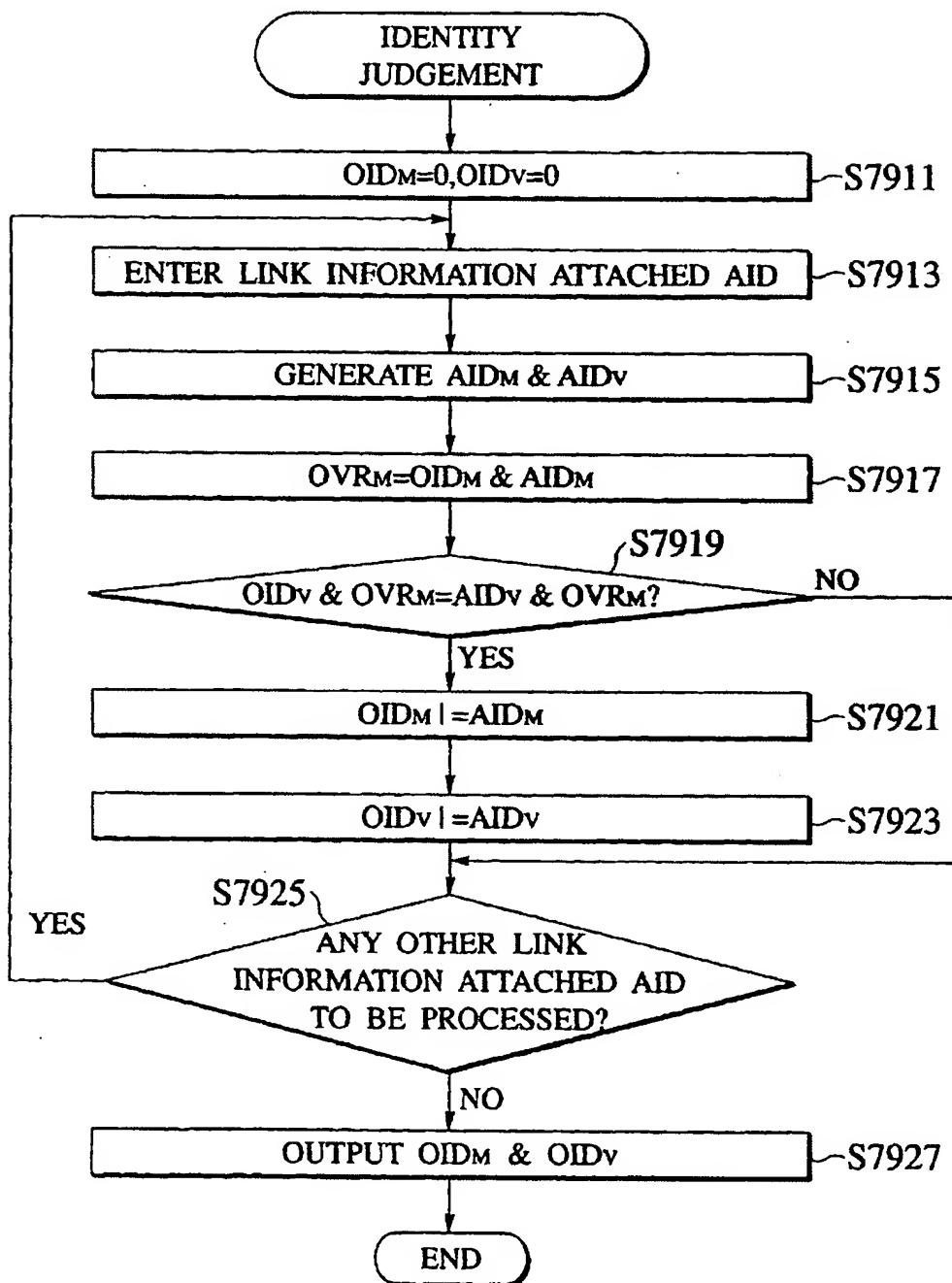


FIG. 39

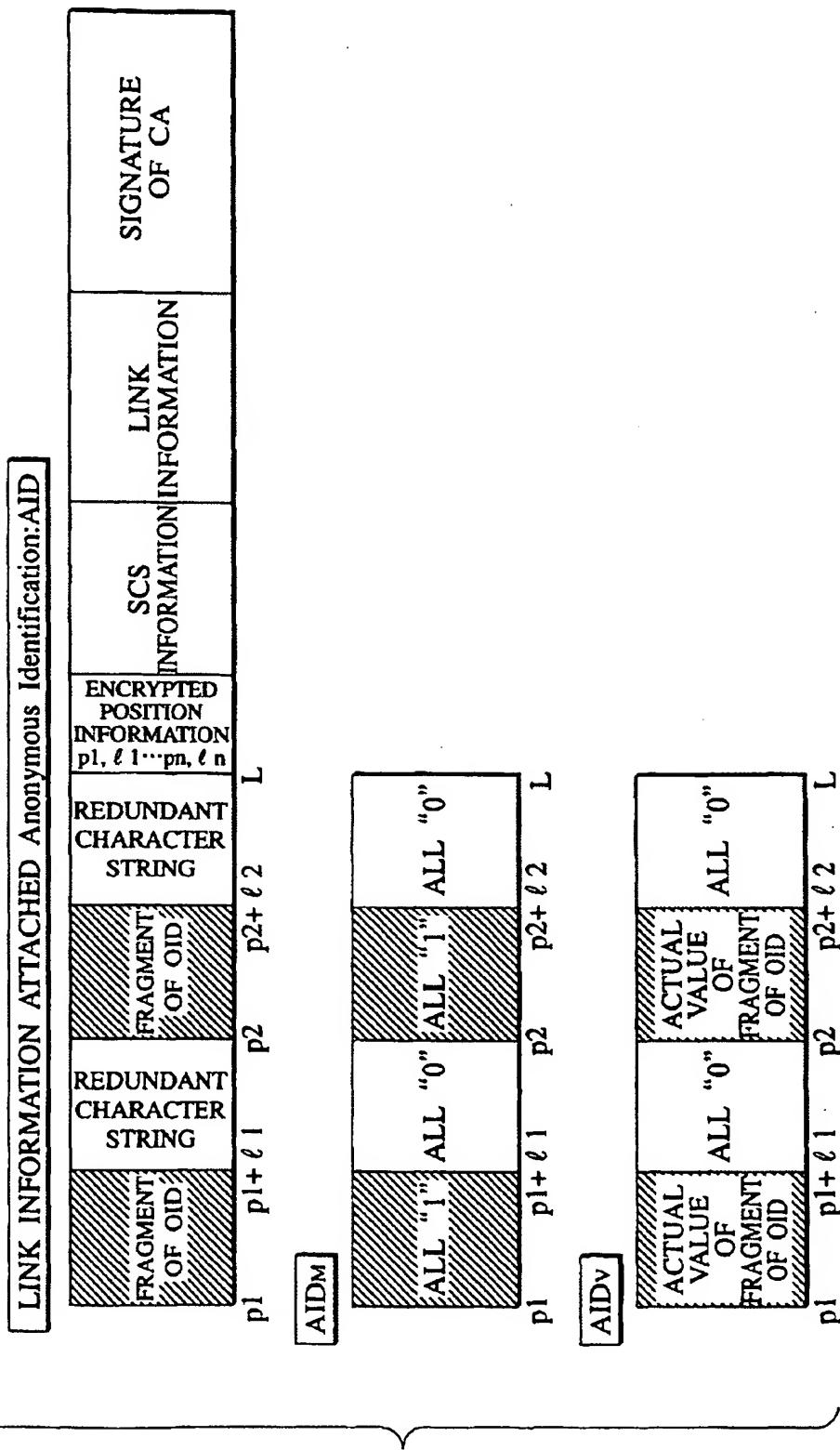


FIG.40

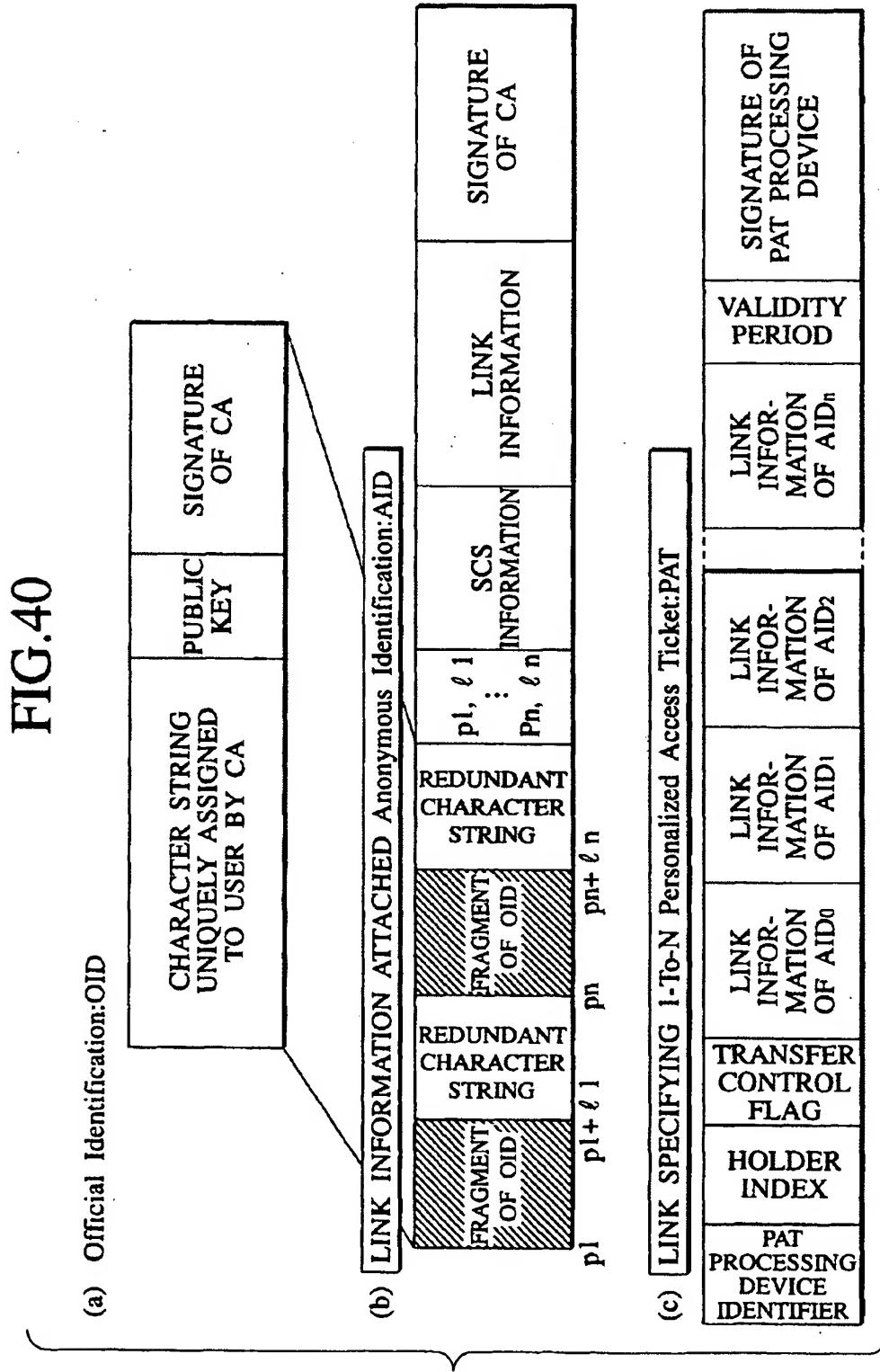


FIG.41

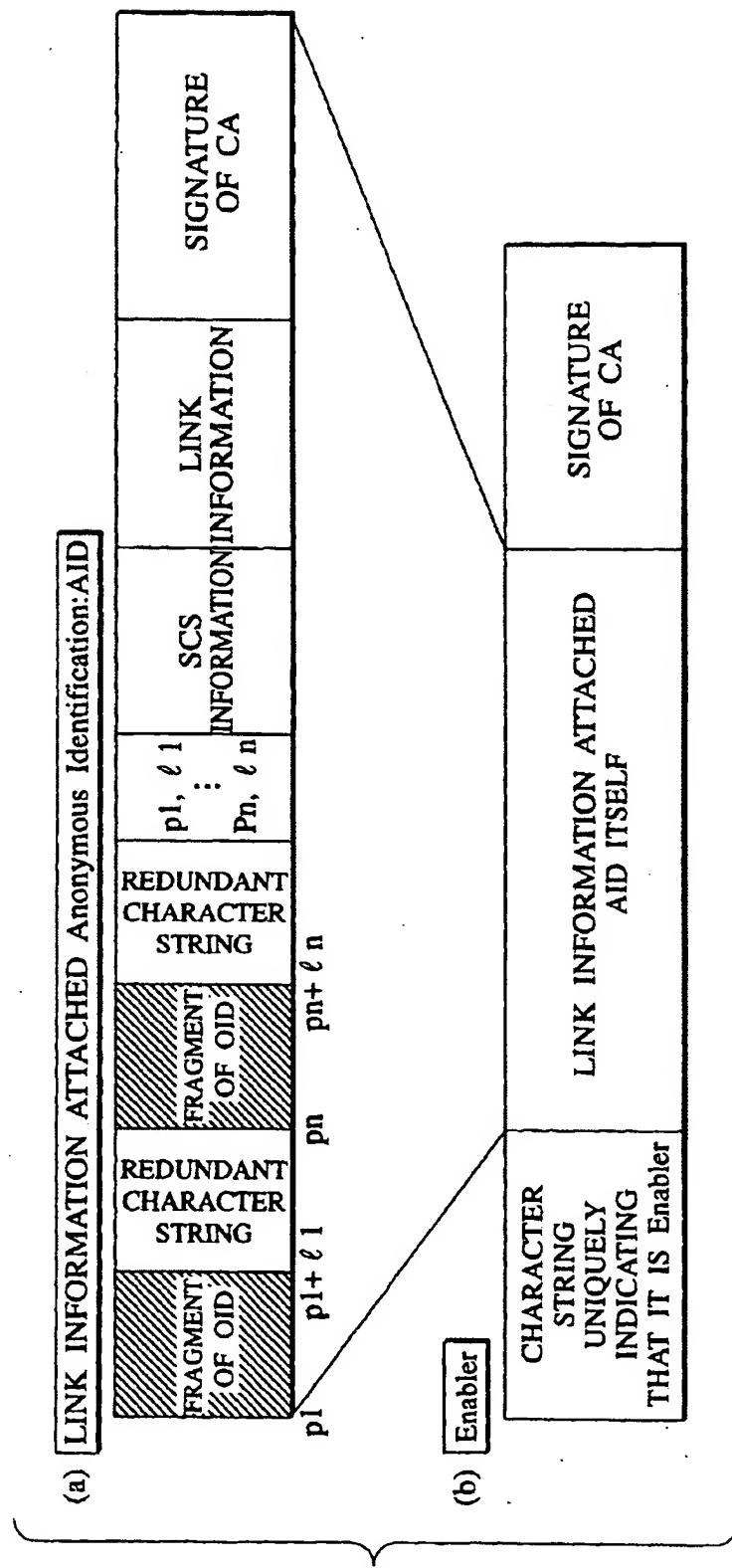


FIG.42

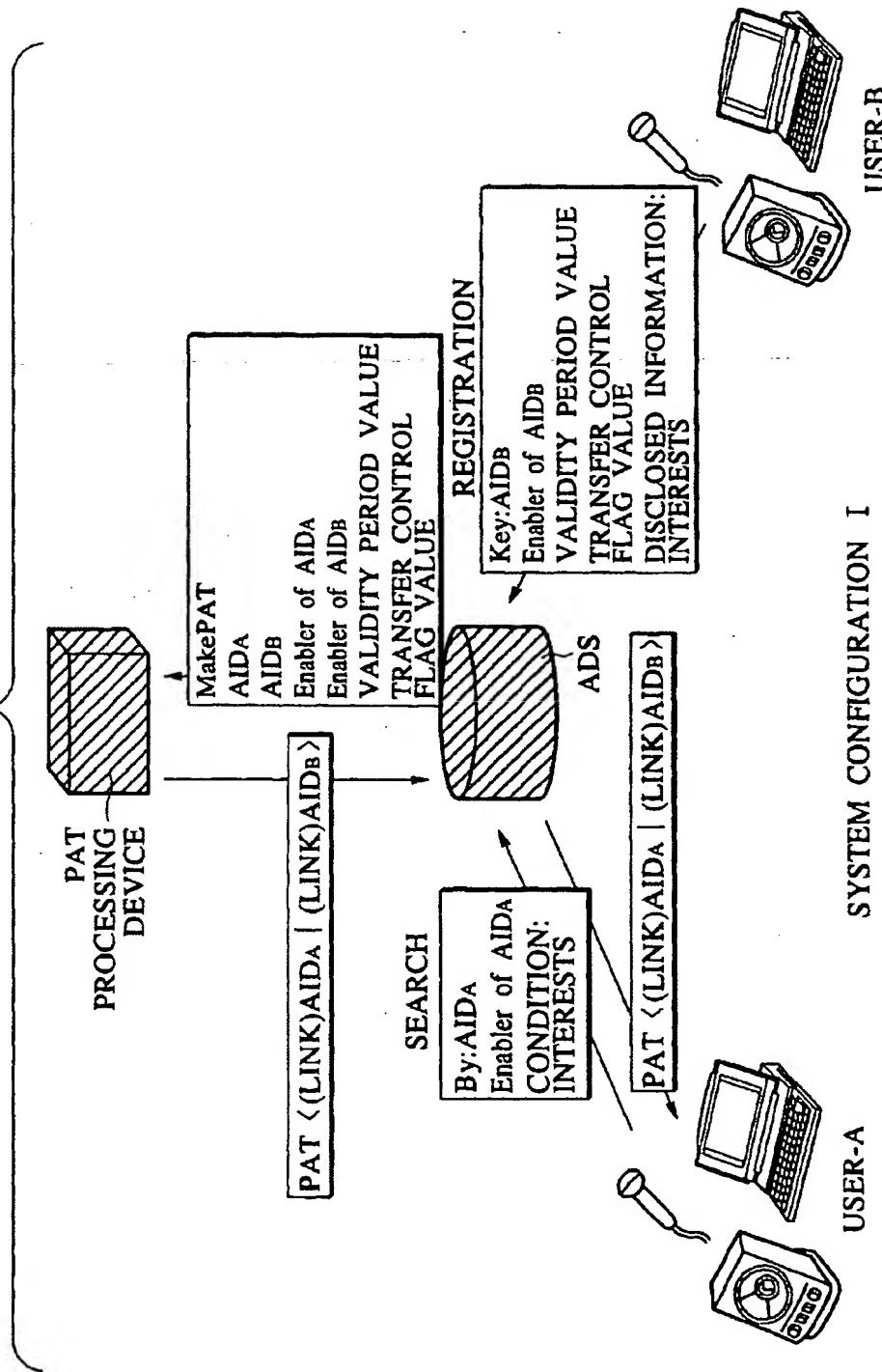


FIG.43

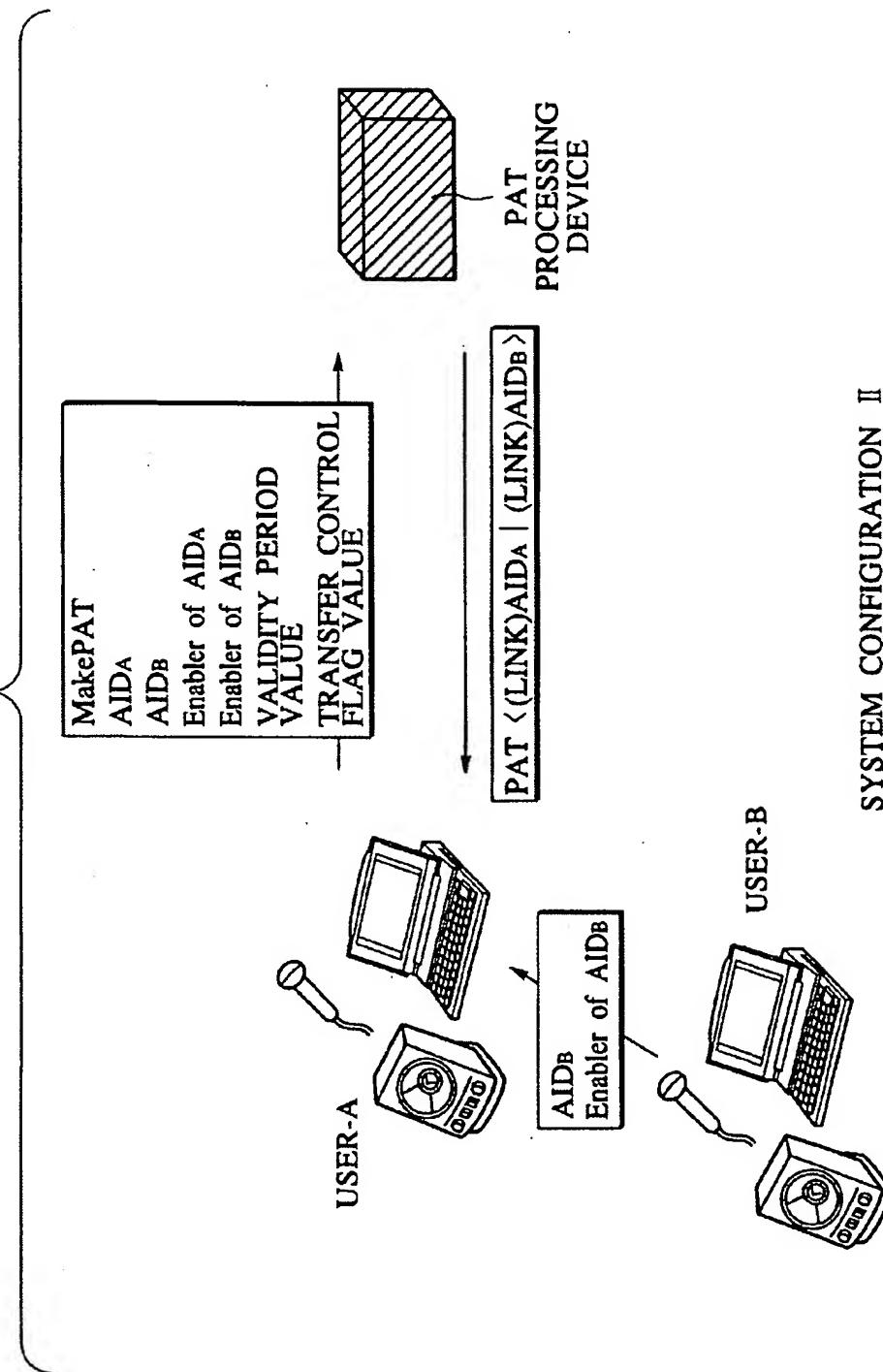


FIG.44

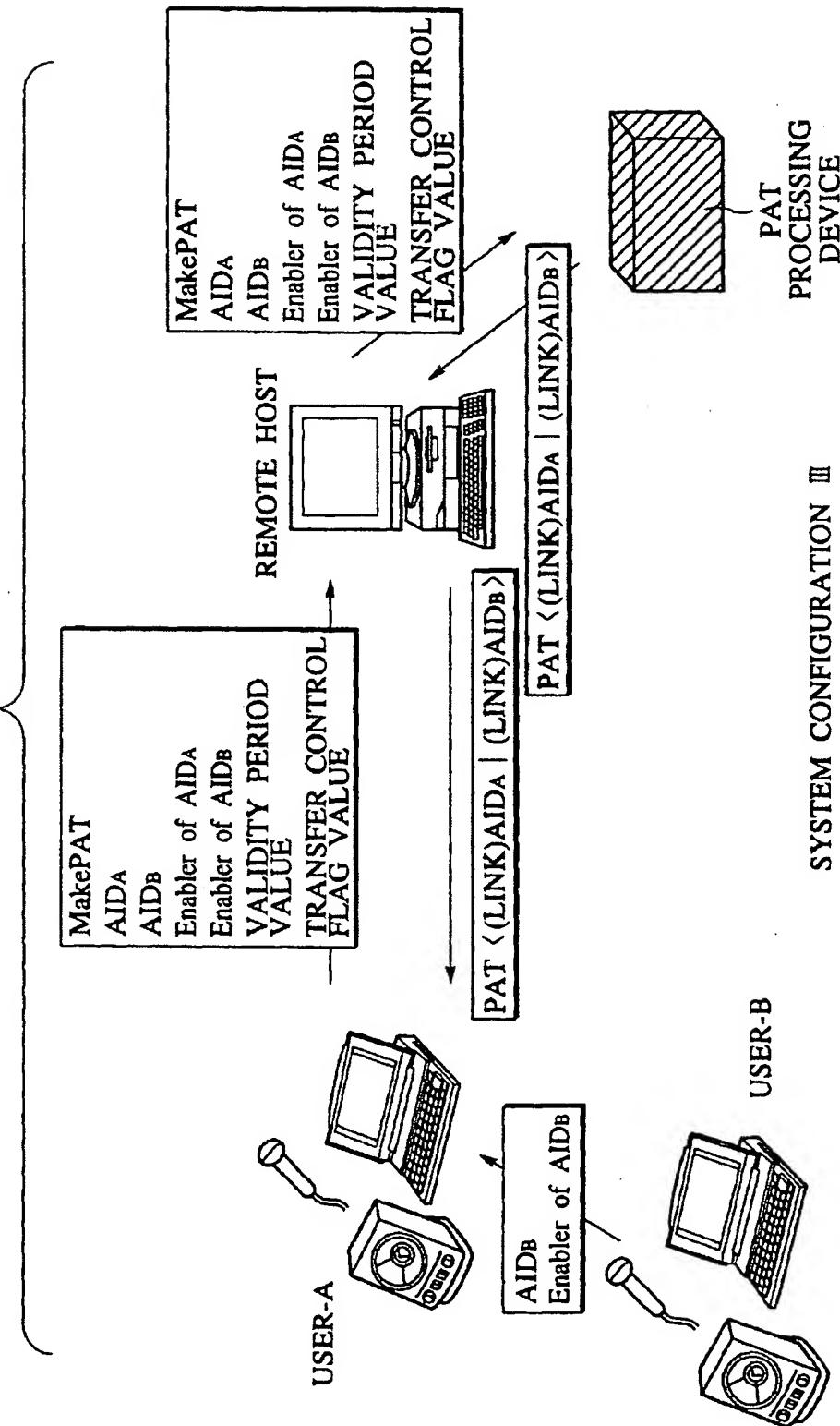


FIG.45

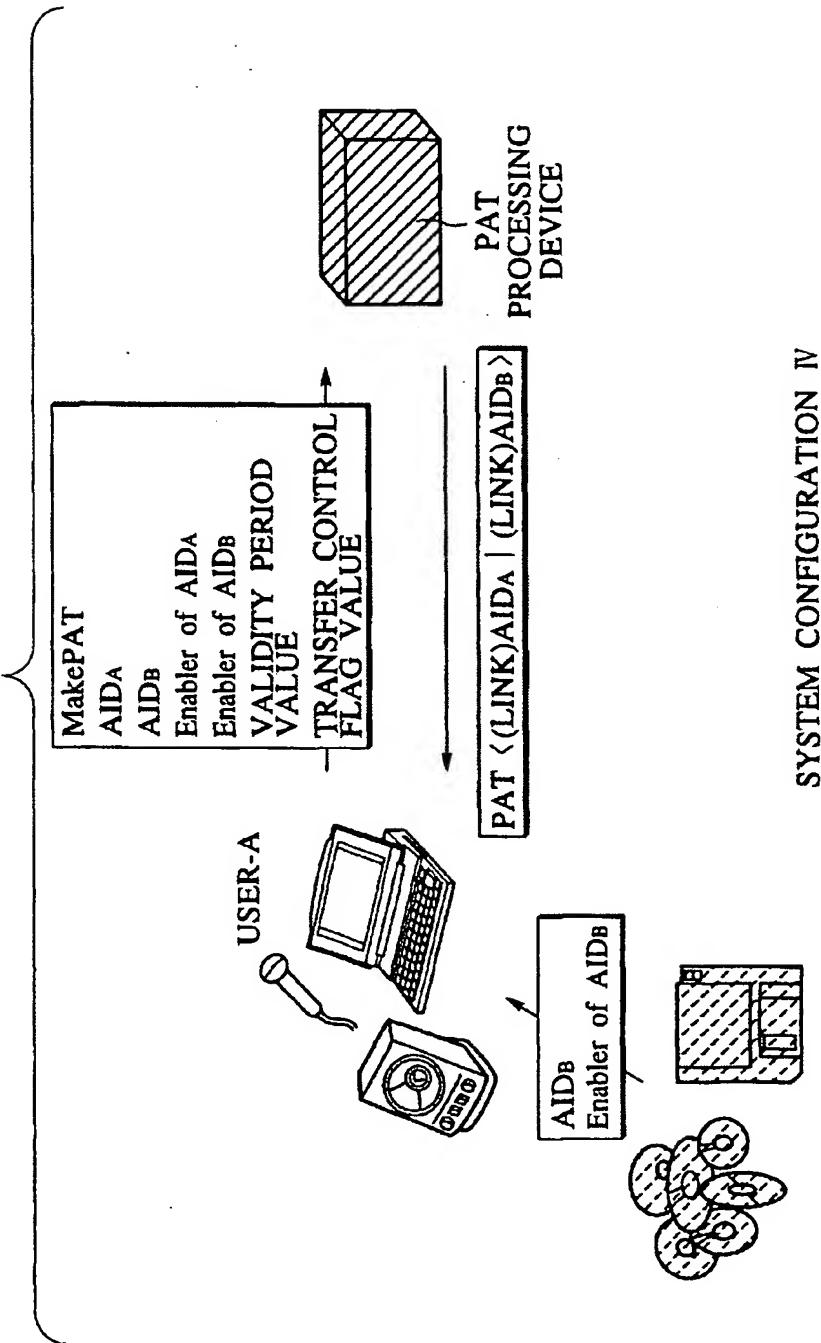


FIG.46

EP 0 946 022 A2

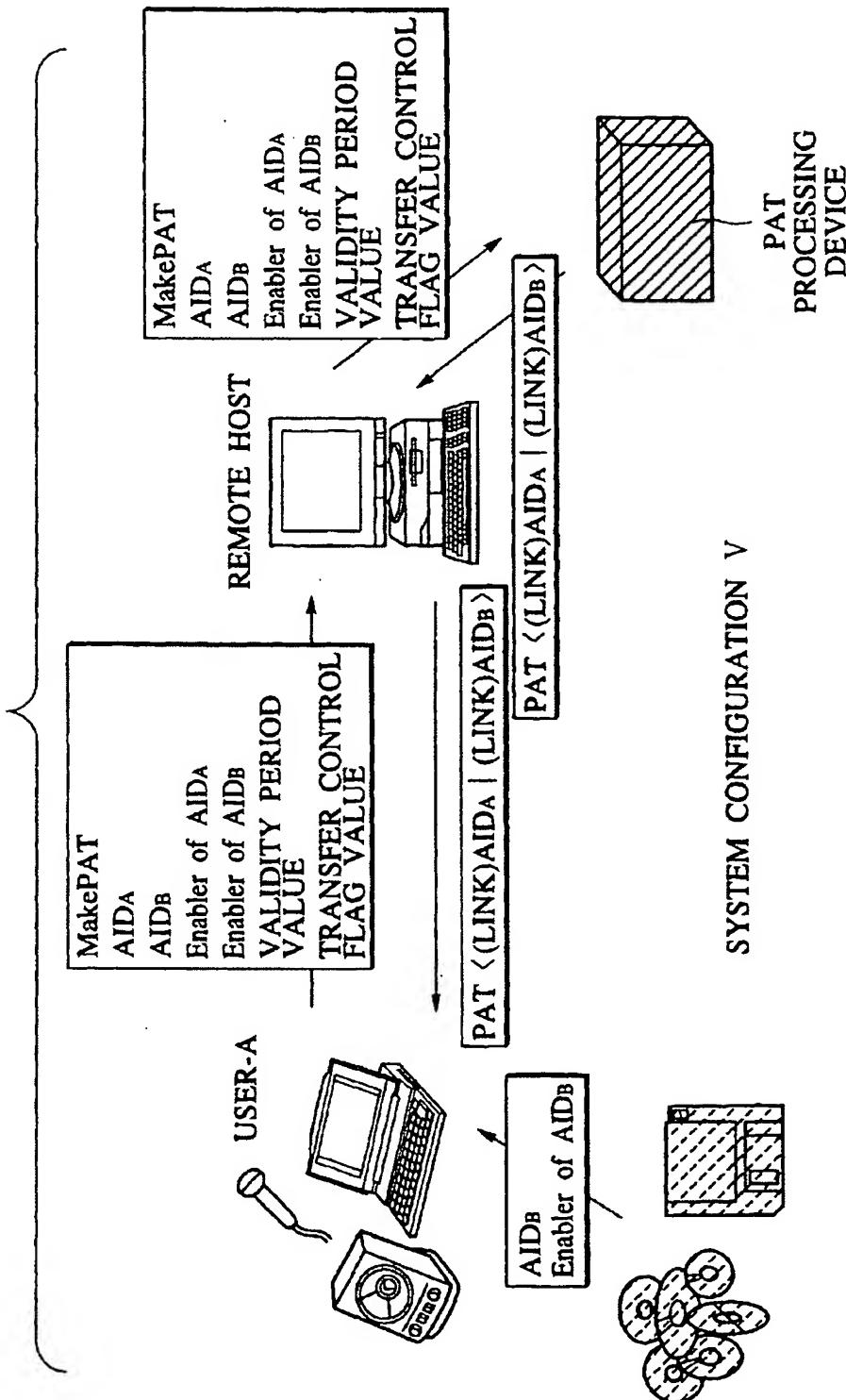


FIG.47

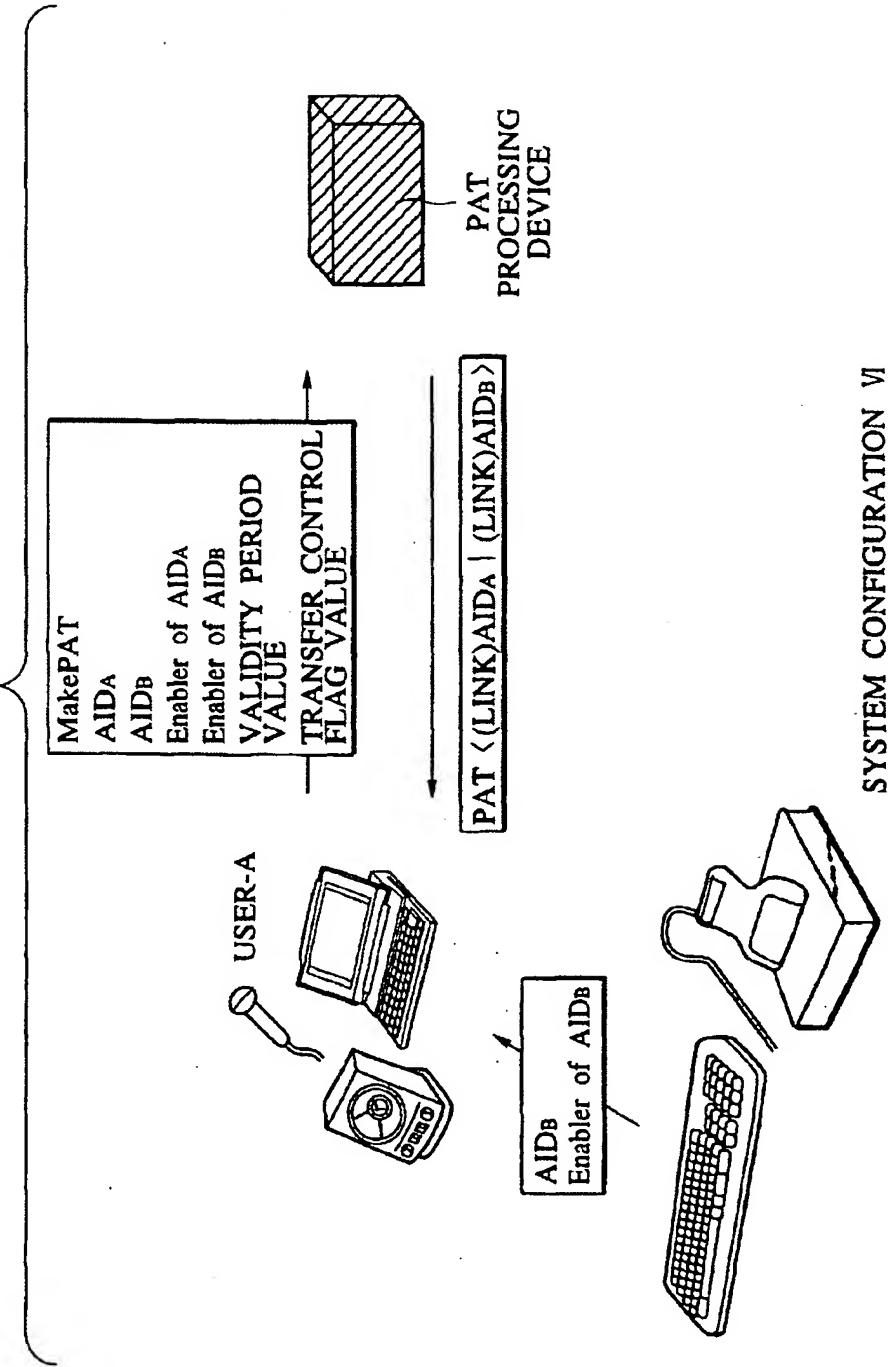


FIG.48

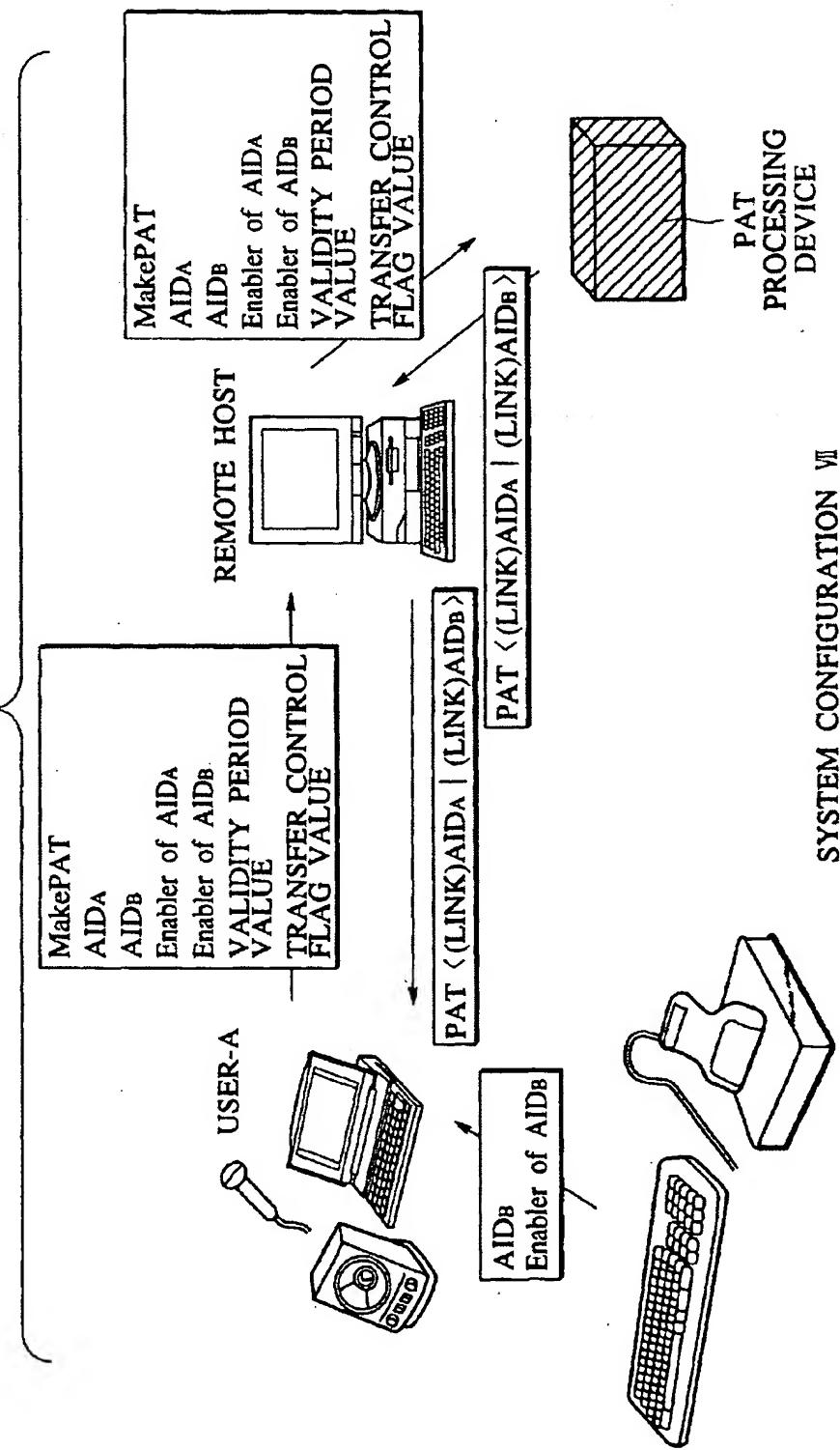


FIG.49

